JUL 1 6 1928

NATURAL HISTORY

May-June
1928

PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.

Price Fifty
Cents

JOURNAL OF THE AMERICAN MUSEUM OF NATURAL HISTORY

NEW YORK, N. Y.

THE AMERICAN MUSEUM OF NATURAL HISTORY

Scientific Staff for 1928

HENRY FAIRFIELD OSBORN, LL.D., President
GEORGE H. SHERWOOD, A.M., ED.D., Director and Executive Secretary
JAMES L. CLARK, Assistant Director, Preparation
FREDERIC A. LUCAS, SC.D., Honorary Director
WAYNE M. FAUNCE, SC.B., Assistant to the Director and Assistant Secretary

I. DIVISION OF MINERALOGY, GEOLOGY, GEOGRAPHY, AND ASTRONOMY

HENRY FAIRFIELD OSBORN, LL.D., D.Sc., Curator-in-Chief

Astronomy

G. CLYDE FISHER, PH.D., LL.D., Curator

Minerals and Gems

HERBERT P. WHITLOCK, C.E., Curator
GEORGE F. KUNZ, PH.D., Research Associate in Gems
LEA MCILVAINE LUQUER, PH.D., Research Associate in Optical Mineralogy

History of the Earth

HENRY FAIRFIELD OSBORN, LL.D., D.Sc., Honorary Curator-in-Chief

Fossil Vertebrates

WALTER GRANGER, Curator of Fossil Mammals
BARNUM BROWN, A.B., Curator of Fossil Reptiles
CHARLES C. MOOK, PH.D., Associate Curator of Fossil Reptiles
GEORGE G. SIMPSON, PH.D., Assistant Curator of Vertebrate Palæontology
WILLIAM K. GREGORY, PH.D., Research Associate in Palæontology
CHILDS FRICK, B.S., Research Associate in Palæontology

Geology and Fossil Invertebrates

CHESTER A. REEDS, PH.D., Curator

II. DIVISION OF ZOÖLOGY, AND ZOÖ-GEOGRAPHY

FRANK MICHLER CHAPMAN, SC.D., N.A.S., Curator-in-Chief

Marine Life

ROY WALDO MINER, PH.D., SC.D., Curator
WILLARD G. VAN NAME, PH.D., Associate Curator
FRANK J. MYERS, B.A., Research Associate in Rotifera
HORACE W. STUNKARD, PH.D., Research Associate in Parasitology
A. L. TREADWELL, PH.D., Research Associate in Annulata

Insect Life

FRANK E. LUTZ, PH.D., Curator
A. J. MUTCHLER, Associate Curator of Coleoptera
C. H. CURRAN, M.A., Assistant Curator
FRANK E. WATSON, B.S., Assistant in Lepidoptera
WILLIAM M. WHEELER, PH.D., Research Associate in Social Insects
CHARLES W. LENG, B.S., Research Associate in Coleoptera
HERBERT F. SCHWARZ, A.M., Research Associate in Hymenoptera

Fishes

WILLIAM K. GREGORY, Ph.D., Curator
BASHFORD DEAN, Ph.D., Honorary Curator
JOHN T. NICHOLS, A.B., Curator of Recent Fishes
E. W. GUDGER, Ph. D., Bibliographer and Associate
FRANCESCA LAMONTE, A.B., Assistant
CHARLES H. TOWNSEND, Sc.D., Research Associate
C. M. BREDER, JR., Research Associate
VAN CAMPEN HEILNER, M.Sc., Field Representative

Amphibians, Reptiles, and Experimental Biology

G. KINGSLEY NOBLE, PH. D., Curator
CLIFFORD H. POPE, B.A., Assistant Curator
BERTRAM G. SMITH, PH.D., Research Associate
A. B. DAWSON, PH.D., Research Associate
WILLIAM DOUGLAS BURDEN, M.A., Research Associate

Birds

FRANK M. CHAPMAN, SC.D., Curator-in-Chief
ROBERT CUSHMAN MURPHY, D.Sc., Curator of Oceanic Birds
W. DEW. MILLER, Associate Curator
JAMES P. CHAPIN, PH.D., Associate Curator of Birds of the Eastern Hemisphere
JONATHAN DWIGHT, M.D., Research Associate in North American Ornithology
ELSIE M. B. NAUMBERG, Research Associate

Mammals of the World

H. E. ANTHONY, M.A., Curator
ROBERT T. HATT, A.M., Assistant Curator
GEORGE G. GOODWIN, Assistant
FREDERIC A. LUCAS, SC.D., Research Associate
WILLIAM J. MORDEN, Field Associate

Comparative and Human Anatomy

WILLIAM K. GREGORY, PH.D., Curator
S. H. CHUBB, Associate Curator
H. C. RAVEN, Associate Curator
J. HOWARD MCGREGOR, PH.D., Research Associate in Human Anatomy
DUDLEY J. MORTON, M.D., Research Associate

III. DIVISION OF ANTHROPOLOGY

CLARK WISSLER, PH.D., Curator-in-Chief

Science of Man

CLARK WISSLER, PH.D., Curator-in-Chief
PLINY E. GODDARD, PH.D., Curator of Ethnology
N. C. NELSON, M.L., Associate Curator of Archæology
HARRY L. SHAPIRO, PH.D., Assistant Curator of Physical Anthropology
MARGARET MEAD, PH.D., Assistant Curator of Ethnology
GEORGE C. VAILLANT, PH.D., Assistant Curator of Mexican Archæology
WILLIAM K. GREGORY, PH.D., Associate in Physical Anthropology
CLARENCE L. HAY, A.M., Research Associate in Mexican and Central American Archæology
MILO HELLMAN, D.D.S., Research Associate in Physical Anthropology

IV. DIVISION OF ASIATIC EXPLORATION AND RESEARCH

ROY C. ANDREWS, D.Sc., Curator-in-Chief
WALTER GRANGER, Curator in Palæontology
CHARLES P. BERKEY, PH.D. [Columbia University], Research Associate in Geology
FREDERICK K. MORRIS, A.M. [Central Asiatic Expeditions], Associate in Geology and Geography
AMADEUS W. GRABAU, S.D. [Geological Survey of China], Research Associate

V. DIVISION OF EDUCATION AND PUBLICATION

GEORGE H. SHERWOOD, A.M., Curator-in-Chief

Library and Publications

IDA RICHARDSON HOOD, A.B., Acting Curator
HAZEL GAY, Assistant Librarian
JANNETTE MAY LUCAS, B.S., Assistant Librarian—Osborn Library

Education and Public Health

GEORGE H. SHERWOOD, A.M., Curator-in-Chief
G. CLYDE FISHER, PH.D., LL.D., Curator of Visual Instruction
GRACE FISHER RAMSEY, Associate Curator
WILLIAM H. CARR, Assistant Curator
NANCY TRUE, A.B., Assistant
PAUL B. MANN, A.M., Associate in Education
FRANK E. LUTZ, PH.D., Research Associate in Outdoor Education

---

CHARLES-EDWARD AMORY WINSLOW, D.P.H., Honorary Curator of Public Health
MARY GREIG, A.B., Assistant Curator of Public Health

Printing and Publishing

HAWTHORNE DANIEL, Curator, and Editor of *Natural History*
A. KATHERINE BERGER, Associate Editor of *Natural History*

Public Information

GEORGE N. PINDAR, Chairman
GEORGE H. SHERWOOD, A.M.
WILLIAM K. GREGORY, PH.D.
WAYNE M. FAUNCE, SC.B.
CLARK WISSLER, PH.D.
HAWTHORNE DANIEL

Advisory Committee on Natural History Magazine

HAWTHORNE DANIEL, Chairman

HENRY FAIRFIELD OSBORN, LL.D., D.Sc.
CLARK WISSLER, PH.D.
GEORGE N. PINDAR
FRANK M. CHAPMAN, SC.D.
FRANK E. LUTZ, PH.D.
GEORGE H. SHERWOOD, A.M., *ex-officio*
A. KATHERINE BERGER

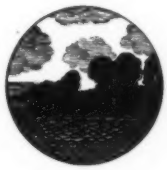
VOLUME XXVIII
NUMBER 3

NATURAL HISTORY

MAY-JUNE
1928

The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor



A. KATHERINE BERGER
Associate Editor

CONTENTS

A MONGOLIAN CAMELEER ..... *Cover*
From a Painting by A. A. Jannson

INTERIOR OF THE GREAT CRATER OF VESUVIUS, SEPTEMBER, 1920 ..... *Frontispiece*
Photograph by F. A. Perret

THE WIZARD OF SUIYUAN ..... William Douglas Burden 227
Sport and Travel on the Sino-Mongolian Frontier

THE BUSH NEGROES OF DUTCH GUIANA ..... Morton C. Kahn 243
African Manners and Customs in the South American Jungle

A MODERN "MEDICINE MAN" IN CHINA ..... Clifford H. Pope 253
Collecting Reptilian Specimens in Fukien Province

INSECTS THAT ERECT TENTS ..... Frank E. Lutz 264
The Habits of the Tent Caterpillar and the Problem It Presents

NEW WORLDS IN THE MAKING ..... Clyde Fisher 269
How Were the Stars and the Planets Formed?

THE HOMES OF A HUMMER ..... Frank M. Chapman 284
A Study in Tropical Bird Life

"ROBINSON CRUSOE'S CHILDREN" ..... H. L. Shapiro 290
A Strange Story and a Strange Family in the South Seas

VOLCANOES IN ACTION ..... Chester A. Reeds 302
With Eleven Photographs and Captions by Dr. F. A. Perret

THE "LOST WORLD" OF MT. RORAIMA ..... G. H. H. Tate 318
The Story of an Expedition into the South American Jungle

Notes 329

Published bimonthly, by The American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

Copyright, 1928, by The American Museum of Natural History, New York

Photograph by F. A. Perret

INTERIOR OF THE GREAT CRATER OF VESUVIUS, SEPTEMBER, 1920

The 1906 eruption left a vast crater 720 meters in diameter by 700 meters deep. By 1920 the lavas erupted from the active conelet seen in the middle distance had filled the crater to within 200 meters of the top. As these liquid lavas spread over the surface of the basin, they cooled, forming a solid plug, except for the conduit connecting the conelet with the molten magna below. This building process goes on until another great eruption ends the cycle, when the process starts anew.

See page 302, "Volcanoes in Action"

VOLUME XXVIII

NATURAL HISTORY

NUMBER THREE

MAY-JUNE, 1928

THE WIZARD OF SUIYUAN

A Story of Sport and Travel on the Sino-Mongolian Frontier

By WILLIAM DOUGLAS BURDEN

Trustee and Research Associate in Herpetology, American Museum

IT was twilight as we shuffled up ankle-deep in the Chinese dust and stood under the grim battlements of the north gate of Gweihwachang, while a camel caravan from the endless solitudes of the Gobi sifted silently by and was swallowed up by the blackness of the arch.

There was something in the walls that stretched out massive and formidable against the evening sky, something in the character of the grand old watchtowers, something in their very atmosphere, that bespoke the lurking mystery of the frontier. Overhead, a rusted iron grating disclosed a grinning head that leered at us suggestively in token of the law of General Ma, Dutung of Suiyuan. A pigtail dangled idly between the bars of the cage. We passed on through the darkness of the arch and came at one step into a great city.

Without, there stretched a waste of desert, mountain, and plain, horizon upon horizon; within, was the hectic bustle of urban life. An immense volume of sound floated up with the dust and hung suspended over the low buildings—cries of shepherds, cracking of whips, the sharp shout of muleteers, the rumbling of studded wheels, the complaining shrieks of ungreased axles, the barking of dogs—all this filled the air with a constant roaring like the roaring of ocean waves.

It was the first night of the mid-autumn festival, a grand jamboree that penetrated every dark corner of the city, and, through this din and turmoil, a few quiet old musket-armed Mongols passed indifferently by, leading their shaggy-necked ponies down the dim alleyways. We threaded our way gingerly through narrow streets to the British-American Tobacco post. The Britisher in charge was in his cups. He had planted himself in the street and there stood gesticulating like a maniac, while a sea of yellow faces stared impassively out of the gloom. Chinese poured from his mouth as fluently as liquor had poured in. All traffic was blocked and the coolies waited patiently for this fit of foreign temperament to distil itself away. At our approach, the B. A. T. man, sighting foreigners for the first time in many moons, came out of his frenzy. To be alone with the Chinese, that was his lot and also his excuse for the bottle. After a few drinks, during

THE MOUNTAINS OF THE MOGOLIAN FRONTIER

In the distance may be seen the isolated mountains which are the home of *Ovis ammon commosa*. The evolution of this race is due to the fact that these mountains are cut off from the range of other wild sheep. Without isolation, subspecies will interbreed and soon will cease to exist. Thus isolation is necessary not only for the origin but for the maintenance of species, and it is therefore an essential factor in evolution

which our host gave us the gossip of the frontier, we went to an inn. Chu, my Chinese boy, served us supper. So here we were at last thrown back into ancient China,—a China that has been without apparent change for five thousand years. And beyond the walls of Gweihwa there stretched away under a starry sky the vast unknown spaces of Central Asia.

From the elevated plateau to the northward a pass tumbles down through the mountains to the plains of China. It is one of the great caravan routes between fertile China and the arid wastes beyond. In these mountains the bandits, the wolves, and the Mongolian argali make their homes side by side. The wolves and the bandits were not without interest, but it was the Mongolian argali—the great Asiatic sheep—that really occupied our thoughts. General McCoy, Major Magruder, Sears, and I pored over a map by candlelight, making our plans.

Next morning, on our way across the flats to the foothills, we met No-man-gin, the famous Mongol hunter of Suiyuan about whom we had heard in Peking. His eye was "stronger than the eagle's;" his knowledge of the sheep "an instinct." No-man-gin, one-time bandit, now large, fat, and prosperous, appraised us with glittering eye. Yes, for a mere dollar a day, he would find the great sheep. He led the way. We followed trustingly, while the old scoundrel plotted and planned and laughed up his sleeve at his gullible quarry.

In a few hours we were already in the hills. The north wind that came howling out of Mongolia brought with it the bitter cold of the Gobi Desert—a taste of the winter to come. We crossed a divide and dropped into the growing gloom that

seemed to hide a little mud village in the loneliness of those wind-swept mountains—just a cluster of huts surrounded by a compound wall—as if left there discarded on the barren flank of a gray hill. No-mangin ordered a family to vacate their dwelling in our favor. Docilely they obeyed, scurrying out with all their possessions. We tottered into the smelly darkness. It was damp and cold. A coolie was summoned to fire the "kang." He squatted on the dirt floor, feeding grass to a pathetic flame that needed constant attention. Except for a bit of joss-wood, the hills were utterly destitute of timber, so that grass and argol were the only fuels. The attempt to produce heat was a dismal failure. Volumes of smoke poured into the chamber. Half suffocated, we fled to the courtyard and there waited till the noxious clouds had trickled out through rents in the paper windows. So it is that the Chinese protect themselves against the ravages of winter.

After that, we bundled up in sheepskins, caught colds, and sat down by candlelight to a game of chess on an improvised board. A varied array of cartridges took the place of knights, bishops, and castles. Then we retired and tried to enjoy a little hard-earned rest. But the animals had something to say about that. The donkeys brayed incessantly. Dogs barked for hours on end, and conducted midnight fights up and down the courtyard. Cats squalled on the roof tops, and crawled through the paper windows into our sleeping quarters. Unearthly moanings sounded from adjoining rooms, through the long hours of the night. An attacked pig added his shrill squeals to the general disturbance, and now and then a wolf howl in the distance gave the village pack another chance to exercise its vocal chords.

TWO OF MY COMPANIONS ON THE HUNT

General McCoy (left), somewhat grizzled and gray but clear of eye, carried his years lightly, proving that they are but a trifling burden to a veteran campaigner in many lands. Major Magruder (right) has traveled north, south, east, and west, under the Dragon flag

THE HOME OF THE BANDITS, THE WOLVES, AND THE GREAT ASIATIC SHEEP
In the distance are the plains of China, which stretch away to the Yellow Sea. In the foreground is No-man-gin, the "Wizard of Suiyuan"

It is not in the nature of a Chinese to be in the least disturbed by braying donkeys, squalling cats, grunting pigs, unearthly moanings, and endless barking of dogs. He finds nothing in these sounds sufficient even to warrant comment, and therefore accepts them just as he accepts the filth of the courtyard that blows up into his face. We alone were the victims.

That was our first night in a Chinese village. Thirty more were to come, and they varied only in the quality of perfumes, quantity of noise, and degree of discomfort. Yet, though the pleasures of a roaring camp fire and the romance of camping in the wilderness were not ours, we were amply compensated by the privilege of viewing at first hand the age-old customs of the most ancient civilization in the world.

The next morning we headed back deeper into the hills. That canny old rascal, No-man-gin, wanted to bait us, to raise our hopes, to whet our desires by giving us a glimpse of the great sheep. That, he thought, would satisfy us for awhile, and delude us into thinking that we were in good country. Failure would then untie our purse strings, and when the reward on a good head reached a really desirable figure, the old Mongol would then turn the trick in a day or two.

Such was No-man-gin's understanding of the white man. To that extent were we mere pawns in his hands, whom he could move at random through a maze of intricate mountains with the finesse of a master. He took us to a "passing ground," a place sheep frequently cross on their travels from one range to another, a spot where you can see them occasionally as they restlessly pass by, but where you can seldom make an effective stalk. No-man-gin knew the spot exactly. He told us all to be very quiet while he slipped up to a shoulder of rock at the bottom of the

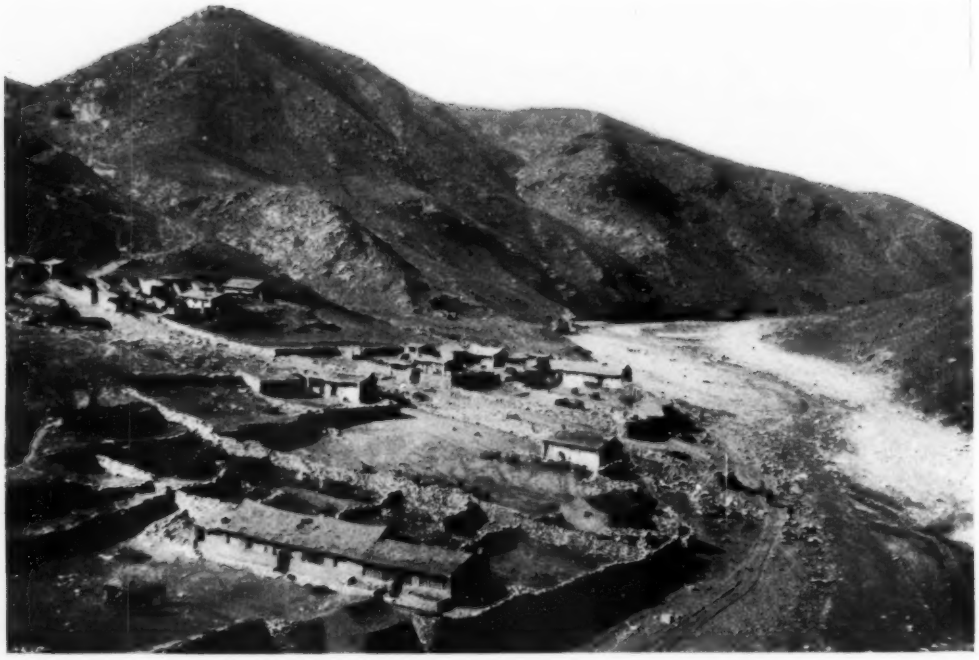
cañon. Then he waved to us, and we passed out around the bend. Suddenly No-man-gin pointed. A great solitary ram had mysteriously appeared on the rim wall a thousand feet above us. His strong shoulders, proud neck, and thick-set, curling horns were silhouetted against the sky. In that one picture I seemed to see the very soul of the Mongolian argali. As he stood there, a chiseled image on the sky line, I could well understand why *Ovis ammon* has been so often described as the grandest of all big game.

Sears and the General made a short stalk. A couple of shots echoed up and down the cañon, and Mr. Ram leaped away unscathed.

After that we had a week of futile hunting, that consisted of long, hard, blank days in which sheep were seldom even sighted. Major Magruder had the luck to bag a beautiful goral, (a species of goat-antelope, *Nemorhædus goral*), and the General secured an Asiatic roe deer. These last were as wary as they were plentiful, and therefore offered excellent sport. As to the sheep, we grew daily more impatient. The General stayed out every night until it was pitch dark. Sears, ever restless on the trail, fretted and worried himself half to death over our ill luck, and I covered country as fast as my legs would carry me, while Magruder philosophized on the beauty of the mountains, and No-man-gin giggled up his sleeve.

At the end of ten long days we headed off for Dung Wushitu (East-West Village), the home of No-man-gin at the base of the mountains. I am still calling them mountains, but actually they are not. To a physiographer, the formation is that of a cuesta with insequent rivers that have eaten back into the nearly horizontal strata of the cuesta scarp, carving out of it a series of complex winding cañons. Dung Wushitu is situated at the mouth of one of these cañons, where it debouches

ON THE TRAIL
The ever faithful "Chu" in the lead. Load a donkey to the "brim" and there is always room left for a Chinaman on top



A CHINESE MOUNTAIN VILLAGE AT WHICH WE STOPPED

Every night the courtyard was filled with camel caravans, goats, pigs, cattle, and dogs, and the million and one strange sounds which resulted from this conglomeration of beasts. Every day we saw the life of the great Pass. Mongols shuffled by on tireless shaggy-haired ponies. Endless trains of camels moved off silently on soft, rubber-like pads

from the escarpment face on to the plains of China. It was distant fifty li—about seventeen miles—so, having ascertained its general direction, I started off without a guide, as I was determined to give myself the pleasure of hunting alone.

I said good-bye to the others at an early hour. A strong wind was blowing out of the northwest and, during the night, ice had formed in all the little patches of quiet water in the stream bed. For about four miles I struck out over the ridges to some good roe deer ground. The country was rough and rocky. I crawled around among the miniature ravines, peeping over wind-torn ledges, peering into purple gorges where the roe hopped nimbly out of view. I saw many of these graceful, shy little creatures, but they were all does. Then I had luncheon behind a sheltering rock. The upland was a partially dissected plain. There was a perfect accordance of summit levels, and it was wonderful to note the symmetry of stream erosion in the sedimentary strata. The regular diversity in the forms and shapes of the terrain, along with the shadows that brought them into relief, and the colors that painted them, were a constant source of pleasure to the eye. Erosion here was in a youthful stage. The greater part of the landmass was still upland.

I felt lazy after my full meal and nearly dozed off to sleep, utterly unapprehensive of the struggle that lay ahead. All the others had gone on to Dung Wushitu, but, after all, what was the hurry, so long as the sun continued to shine and soak into my bones? After a while I began nosing around again among the little ridges, using my field glasses frequently and keeping a constant lookout. I saw several red foxes, which I watched at my leisure, to see if I could gain any points

in the art of stalking. Also, I observed a wild cat among the rocks and a few marmots. The skins of these animals may be obtained in Peking for a mere pittance and made up into the most beautiful coats.

Finally, I jumped a buck, but he was too quick, and disappeared from view in two flying leaps that hardly gave me time to pull the trigger. He had been lying down, concealed in some heavy grass, and had therefore escaped my vigilance.

Late in the afternoon, I descended into the gloom of the deep cañon beneath. The skies had suddenly become overcast. By the time I had scrambled down into the bottom of this dreary gorge, night shadows were already sweeping over the sky. So there I was, with some thirty-five or forty li ahead of me, and no moon to light the way.

"Stupid fool," I thought to myself, "you'll have to pay for your day-dreaming, now."

In less than an hour the night was inky black, and I found myself stumbling painfully down that bowlder-strewn gorge, the narrow walls of which soared up almost vertically for more than six hundred feet. Gusts of wind swept down the cañon. It was a cold wind, that came from the lonely distances behind. The river was roaring in my ears, an everlasting, ominous sound that seemed to add confusion to the darkness. As I looked aloft, I could see a dim gray light, and the vague outlines of heavy clouds streaming by on their way to Dung Wushitu. Beneath that dim grayness was a deep pit of solid black with sharp, invisible rocks and tumultuous snarling waters. It was as though I were in a dream, following the sacred river through "caverns measureless to man." And then, as I

COOLIES BEFORE A HOUSE AT WHICH WE STOPPED

A foreigner finds it a little difficult to accustom himself to some of the habits of Chinese coolies. They are past masters, for example, at making the most disagreeable sounds imaginable, and handkerchiefs, of course, do not exist

TAKING TIFFIN EN ROUTE TO JIRGO
Such narrow valleys as these offer the bandits all that is necessary for a successful surprise attack

fell again, and cursed, and failed even in the satisfaction of hearing my own curses, I thought "What a likely lair for brigands." The cañon zigzagged in sharp, angular turns, back and forth, back and forth, everlastingly. I was constantly wading and rewading the ice-cold stream. Due to the violence of the torrent, the slipperiness of the slimy rocks, and the blackness that I had to push against, there was a certain hazard to this journey. Had there been any timber, I would have built a fire and camped out quite comfortably for the night. But there wasn't, so I just felt my way along, stubbing my toes sullenly, stumbling and falling until bone and flesh were bruised and bleeding. "The thousand natural shocks that flesh is heir to—" I kept thinking.

Finally, my Chinese felt slippers, which I had been wearing in the hills for comfort, gave way completely under the strain. Nails bit through the bottom into my feet, and the slippers themselves became so like wet paper that they lost all shape and kept coming off. After several prolonged searches for them in the darkness, I tied them on with some rope. This held them properly, but they were so soft that they offered no protection against the rocks. At last, in some distress, I stopped, put on my Alaskan parka, and sat down. Small comfort in this, however!

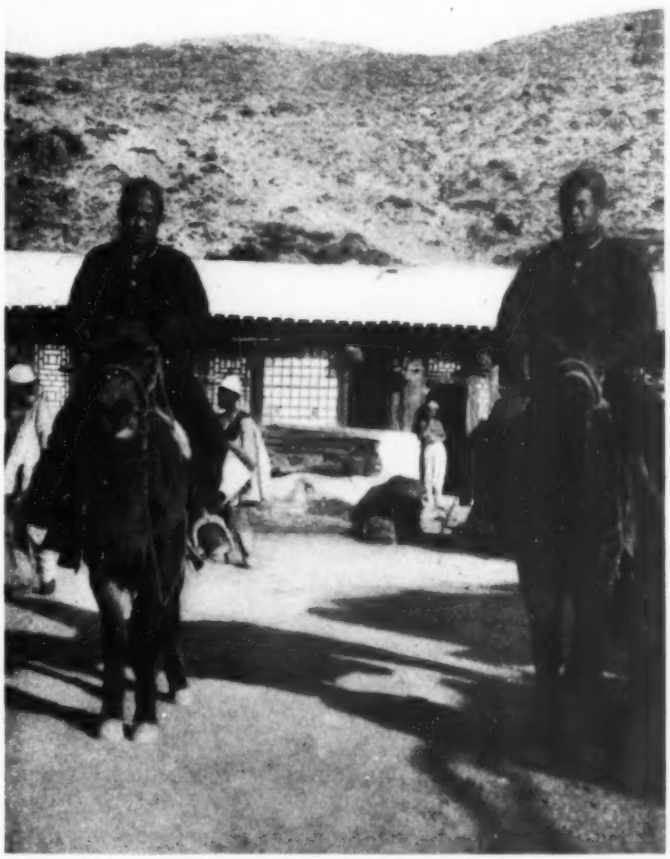
The cañon to me was *terra incognita*. I knew it led to China, but no more. The wind was increasing. The frost was biting harder. This was a poor place for tired muscles to rest.

I have often traveled alone, and usually I like it, but not this time. "A dismal place," I thought, "this cañon on the Sino-Mongolian frontier." While meditating thus, I ate what remained of my emergency rations. Then I stumbled on again, not for minutes, but for hours, while the cañon seemed to sink deeper into the earth, so that even the friendly sky overhead became no more than a

thin ribbon of gloomy gray, as distant as the stars. Then, suddenly, the walls of rock broke in front of me, and that seemingly subterranean river which had been fighting savagely with its hidden banks, swished out under a broad open sky, and went whispering away into the distance over the plains of China. Broad spaces stretched on every side. I couldn't see them but I could feel them. It was like coming out of the shaft of a mine at night. The wind behind me howled among the mountain-tops. That, and a gentle whispering of waters was the only sound. I felt very lonely as I stood there and listened and debated what to do next. Then I sat down again.

Suddenly, I heard a dog bark—sharp, staccato yelps, that came like calls of welcome out of the night. I steered for the sound, nearly stepping over a river terrace bank perhaps twenty feet high, on the way. Finally, I found myself against the outer wall of a Chinese compound. A little boy was singing in the courtyard behind the wall. I called out. The singing stopped. The barking began again furiously. The boy appeared bearing a light. He held it close to my face, and then ushered me inside. What a pleasure it was to get into a warm, lighted room!

There were about ten people sitting on the heated "kang." It was a typical Chinese peasant family. A dried-up old woman, her face furrowed with lines and creases, gave me some tea, and some dry food that reminded me of dog biscuits, and required strong teeth. After that, attempts at conversation produced no end of laughter on both sides. I drew maps, I waved, I gesticulated, I tried everything that ingenuity could suggest. They couldn't and wouldn't understand. Finally, I brought out a large, fat, shiny Yuan shi Kai silver dollar, and placed it conspicuously on the table, under the candlelight. Its radiating silvery glint would, I felt sure, increase their understanding. It did, with the result that after half an hour I succeeded in conveying the idea that whoever would lead me at once



OUR BODYGUARD

General Ma, Dutung of Suiyuan, with the power of life and death over several million people, was solicitous of our welfare. The bodyguard, seen above, arrayed in the Dutung's own colors, was therefore sent to protect us

THE HUNTING COUNTRY ON THE MONGOLIAN BORDER
A windy rift where the first shot was fired

to the "datien" or inn at Dung Wushitu would be the recipient of that beautiful coin. Some lanterns were lighted and I set out again with a noble escort of two Chinese boys. I had no idea how far we had to go, but luck was with me. It was a bare two miles. As we came into the village, the wild, half-starved Chinese dogs displayed their customary animosity in a villainous fashion, and almost attacked us. We kept them off with stones. Then, finally, as I stepped in among friends and received all the kind attentions which the faithful Chu knew so well how to administer, and the brandy had had time to send a warm glow radiating to my very finger tips, I could but mutter, "General, ain't it a grand and glorious feelin'!"

The next day General McCoy and the Major had to leave for Peking. Very sorry we were to have them go and they sorry to leave. Grand sportsmen both. Thus Sears and I were left alone to the wiles of No-man-gin, who knew full well that as soon as we shot a good ram or two we would probably pack up and leave. His aim, of course, was to detain us as long as possible. We therefore took the matter in our own hands and determined to go through to Jirgo, distant about ninety li, where we knew some big rams had been seen the year before. Until the true situation dawned on us, we had been completely at the mercy of the old man. He could stand up under a rain of questions, answering whatever was his pleasure—lying whenever a lie was to his advantage—with the greatest equanimity. We had many interviews, all of which availed us nothing. And, at the end, Chu, who had acted as interpreter, would say:

"Please, Masta, I tink it No-man-gin tell velly big lie."

We therefore ignored the ex-bandit's advice, and made our own plans. While we were getting our outfit started on "the long white trail" that winds up the escarpment of the cuesta, an old Mongol rolled into Dung Wushitu with such

stories of bandits that our muleteers simply unloaded the packs and refused to go.

Now at last, Sears and I thought to ourselves, we may catch a glimpse of these famous bandits. Even in Peking, everyone had been talking of "our dangerous undertaking," of "the bandit-infested mountains," etc. We had not even been able to secure the usual passports, so at last in desperation we simply left with nothing but "hoojows," or rifle permits. Then, again, at Fengtien, where we spent the first night on a station platform, there had been endless talk of Hunghutze. Always it was Hunghutze this, and Hunghutze that. Always the bandits seemed to be just ahead, like a shadow on the trail. Now the Dutung saw fit to force a guard upon us. The guard consisted of two perfectly nice soldiers dressed in black. Of course, if any bandits had appeared on the most remote skyline, our distinguished guard would have run like frightened rabbits. Moreover, they did not calculate to impede their possible flight with heavy rifles, and therefore left them behind. But even though our escort was utterly useless, it was necessary to pay them "tea-money." We did not fret much, however, over the additional expense, for we were traveling at less than two dollars gold, a piece, per day.

But to get back to the muleteers. They, having cast off the loads, now disappeared in the byways of Dung Wushitu. As soon as they had sidled away, we summoned No-man-gin, and gave him his orders: "We start immediately." He was to recall the muleteers.

No-man-gin now revealed himself as the bully of his village. The natives, probably fearing lest he return to his former occupation and desiring, therefore,

THE FIRST RAM

Throughout the entire hunt I saw only fifty sheep, and the greater number of these were ewes and lambs. Only five good rams were seen by the party. Now that the rail to Gweihwa offers foreigners easy access to the mountains, the toll on the sheep will be increasingly severe. Since there is no escape from these isolated mountains, there is every indication that this race of sheep is doomed to extinction

A STOP FOR A SMOKE

A wee nip of tobacco fills the pipe, a fight to coax a spark from a piece of flint follows, then three glorious lungfulls, much slobbering and sucking to indicate the satisfaction derived, and we are off again on the trail of the Mongolian argali

to keep in his good graces, treated him with the respect that becomes a Mongol bandit. In Dung Wushitu, No-man-gin's word was law. Now he sat himself down comfortably and let it be known that the muleteers were to return at once. In a few minutes they came scurrying back from every quarter, looking very dejected and sorry for themselves. Soon afterward we were off, headed for Jirgo, a little town, which, report had it, was being attacked by bandits. It was said that part of the town had been burned and many people killed.

Sears was particularly pleased at the prospect of an adventure. The sheep hadn't given him much excitement, so now he was counting on the bandits. For thirty miles we struggled through the mountains. Just before dark we crossed a divide, and looked down into a broad, brown valley that yawned before us. We could just see Jirgo at the bottom of the hollow —a few huts, like raised scars on the landscape, and many little black holes which were doorways to the dugout dwellings in the steep banks of loess. It was dark when we arrived. The bandits had been dispersed, and Sears was woefully disappointed. The village life seemed to be going on as though nothing had happened. But several men had been wounded, and these uncared-for wretches were suffering tortures. One villager was mortally wounded, bullets having raked his body through and through. I gave him a cathartic, an iodine solution for his wounds, and some morphine to make him more comfortable. In a few hours he was clamoring for more.

The day after our arrival was "lucky day." Weddings and funerals alike had been saved up for this festive occasion. Imagine a broad, lonely valley, away up there on the border of Mongolia. Imagine a sprinkling of mud huts and dugout holes in the loess, like bank beaver burrows. Then picture a barbaric, brightly colored procession, fluting and trumpeting up and down the only street. Mother and father stand in their separate doorways,

kotowing solemnly to the groom, who struts proudly by, while the bride, hidden beauty, swings serenely in a chair on the backs of coolies. But she is not quite as sedate as one might suppose, for she is constantly seen peeking out from between the gorgeously colored curtains that surround her —first on one side and then on the other. The village being very small, one such display is considered insufficient, so they trail out into the fields beyond, where, with great difficulty and much talk and laughter, they reorganize and march ceremoniously up the same street again. This maneuver is executed no less than three times.

AN EX-BANDIT OF THE MOUNTAINS WHO ACTED AS OUR GUIDE
Small wonder he wears such a bland, wholly self-satisfied expression, for my luncheon, which had been given to him to carry, had mysteriously disappeared. But, of course, he did not understand that it was *my* luncheon. Oh no! He was quite beyond guilt

The hunting in the neighborhood of Jirgo was very disappointing; in three days I saw one ewe and of her I caught only a glimpse. We began to think of *Ovis ammon commosa* as no more than shadowy phantoms that disappeared over sky lines, to be gone forever. The next day, therefore, we headed out again into new country.

Two long days in the hills followed, during which I saw plenty of tracks of all kinds of game, including wolves, but that was all—only tracks. After having tried so hard and so long and obtained nothing (not even a shot) I vowed that evening to stay until I got a ram. So Sears and I went separate ways. I moved on down the range, and Sears went to Gweihwa, with the idea of going on to Pauto, the end of the trail, the jumping-off place for the wapiti country, and, incidentally, the Mecca of opium smuggling. By the time I reached Lama Tang and got established in a temple surrounded by sneezing and coughing goats, it was too late to hunt. That night I succumbed to No-man-gin. I counted out seven silver dollars under his nose. They were to be his as soon as I obtained a good ram. The next day No-man-gin was a wizard on the trail.

First, we climbed for two hours, stopping frequently for a short breathing spell and a look back to the plains of China, which stretched away endlessly to the Yellow Sea.

THE WRITER ENJOYING THE COMFORTS OF MONGOL DRESS
For less than four dollars all this furry warmth was purchased. A piece of rope around the waist to take the place of a belt, and I was virtually insulated against the cold winds of the Gobi

Suddenly No-man-gin saw a fresh ram track. He studied it critically. Then, without comment, he continued for another hour. At last he crept up on all fours to a ledge of rock that dropped away in front of us to a large, semicircular basin. He was extremely careful not to make the slightest movement on the sky line. Obviously he expected to see something. We looked, but nothing stirred in that whole valley. It was empty and still. No-man-gin, quite undaunted, prepared himself comfortably for a long wait. "Laziness," I thought to myself, but I was wrong, for although all the valleys looked alike, No-man-gin knew with apparent certainty that the ram had selected this particular one. After half an hour had slipped by I was decidedly chilled, and thought it high time to be on the move, and I said so. But No-man-gin refused to budge. He continued to lie there motionless on one elbow like Sohrab on the sand, his eyes searching out every last clump of grass. Suddenly he nudged me and pointed. I looked hard. At last, away off in the bottom of the basin, about four miles away, I made out a tiny speck. When the speck ceased to move, I lost it again.

"That is the ram," said No-man-gin.

I picked him up with my field glasses, and saw, to my joy, a beautiful heavy set of curling horns. One glimpse was enough. We were off. In order to effect an approach unseen, a long detour down into the bottom of a cañon was essential. As we approached the spot after about four hours of hiking, six ewes suddenly appeared on the sky line. They moved out of sight, not much disturbed. We followed to the crest and watched them for about twenty minutes. There were two rams with them too small to warrant shooting. Several times they changed ground, and we changed accordingly, always keeping above them. All the

sheep were quite a distance off, so I had my three-hundred-yard sight up.

Suddenly, No-man-gin, who had wormed his way up to the very edge of the rocky bluff on which we were lying, waved to me frantically. I crawled up just in time to see a grand old ram walking almost directly beneath me, and about to disappear from view under an overhanging ledge. I fired quickly, aiming a little low; but I had failed to put down my three-hundred-yard sight, so the bullet struck the ground just over his back. In a second he was down the ravine and out of sight. I ran to a point of vantage and fired at him as he and two ewes raced up the opposite slope. No-man-gin all this time was nudging me in the elbow, and urging me to shoot. I saw my second and third bullets bite the steep, dusty slope, one just over him, the other just ahead. When I fired my fourth shot, he was within fifteen yards of the top, and about to disappear forever. I never saw where the bullet struck, but, as I was slipping in another cartridge, he stumbled, reared up, and fell headlong down the ravine.

Then we just gave way to exclamations of joy. For a Mongol, old No-man-gin was really excited. Was he happy over my success, or was he thinking of the seven silver dollars? The kick of the gun gave me a violent nosebleed, which the old man clumsily tried to stop with his fingers. But nothing mattered. I was jubilant. All the long weeks of steady hunting without a single shot were rewarded.

The following day Sears, who had by this time returned from Gweihwa, hunted with No-man-gin. He also baited the old scoundrel with seven gleaming dollars. The effect was magical. Late that night he stumbled into the temple with as fine a sheep head as ever I hope to see, the third largest, according to records, that has been taken out of the country.

WELL PADDED AGAINST THE COLD
The Chinese children, unlike ours, learn at a very early age to shoulder the responsibilities of the household

Thus in two days No-man-gin, when the lure was sufficiently attractive to engage his serious attention, demonstrated his ability as the most uncanny and remarkable sheep hunter it has ever been my fortune to know. In each case he accomplished his purpose within twenty-four hours from the time that the bait was dangled before him. So much for No-man-gin, the wizard of Suiyuan. He is an artist whose maneuverings it was a privilege to witness. May others have as much pleasure contending with his ingenuity!

Ovis ammon commosa

Are these sheep dying out? Will they be exterminated? These are questions one is often asked.

They inhabit a range of mountains from which there is little or no opportunity for them to escape. Native hunters are constantly looking for fresh mutton, and now that the railroad has pushed through to Gweihwa, thus offering easy access to the mountains for foreigners with foreign rifles, it looks as though the toll on the sheep would be increasingly severe. Of course there are no game laws, and there probably never will be, for game laws are an unheard-of thing in China. There is every indication, therefore, that this particular species of sheep, *Ovis ammon commosa*, (formerly *Ovis ammon jubata*) is doomed to extinction. It is simply one of many thousands of species which the white man, the greatest killer the world has ever known, will succeed in exterminating.

I have referred elsewhere to "this isolated set of mountains." Here is an excellent example of the importance of isolation in the origin of species. It is well known that isolation in one form or another is an essential requirement for the production of new species, and, furthermore, that the degree of specialization in a given genus necessarily depends to a large extent on the degree of difference between the specific habitats. Environment as a selective factor in evolution is well established, and it therefore becomes apparent that the amount of difference in the environment, in part, at least, controls the degree of specialization. If subspecies were allowed to interbreed, the subspecies would be abolished. Their very existence depends on isolation, which is therefore necessary, not only for the origin but for the maintenance of species, and is therefore an essential factor in evolution.

A MONGOL VILLAGE SOUTHEAST OF THE GOBI DESERT

A Tray for Carrying food

THE BUSH NEGROES OF DUTCH GUIANA

How a Slave Rebellion of Two Hundred Years Ago Freed the African Natives Who Had Been Transported to Serve the Dutch Sugar Planters, and How These Transplanted Free Black Men, Living in the Jungle, Have Carried on the Traditions of Their African Forebears

By MORTON C. KAHN
Cornell University Medical College, New York City

NEAR the northeastern coast of South America, more precisely in the hinterland of Dutch Guiana, there is a unique civilization little known to the white men of this continent. We know much of the strange life of the Congo and of the fascinating customs peculiar to the inhabitants of the African jungle, for a number of explorers have brought from the Eastern tropics the interesting accounts of their experiences. But of the Surinam Bush Negro, Djuka, as he calls himself, who nearly two hundred years ago fought his way from slavery and has since maintained his independence, of the survival of his African customs and craftsmanship, of his medicine and religion, little has been told.

Beginning in the early part of the seventeenth and eighteenth centuries, the Dutch colonial planters cultivated large sugar plantations on the banks of the Lower Surinam and Saramacca rivers in Dutch Guiana. In those days the labor problem was easy: as was the common practice, the planters obtained natives from the West African Coast and compelled the men and women to work as slaves on their plantations. It is of the descendants of some of these African slaves that I write.

In 1750, or thereabouts, a few slaves of the outlying plantations rebelled against their white masters and escaped into the jungle. Others soon reinforced them until their numbers became very formidable indeed. After a series of long and bloody wars, aided by the impenetrable South American jungle, their own bravery, and the sagacity of their leaders, the escaped

THE FIRST GLIMPSE OF A BUSH NEGRO VILLAGE ON THE UPPER SURINAM

The Djuka settlements are situated in the dense jungle on either bank of the river, at intervals of from a half mile to several miles, and ordinarily some distance from the river bank outside the range of any possible inundation. Very often, too, they lie in close proximity to water falls which form some barrier to possible invaders

Negroes gained many victories over the combined forces of the Dutch and British allies. The wise colonial authorities, seeing that any further attempt at recapture was futile, made a truce, and though the attacks upon the Negroes kept up spasmodically for many years, the blacks retaliating by making vicious forays against the outlying plantations, it was finally agreed by both sides to have peace, and complete freedom was granted to the slaves who had escaped.

From that time until the present, the descendants of the revolutionary slaves have remained a free and independent people. Today they live a peaceful, contented, and primitive life in their little villages of thatched huts in the jungles which border the middle and upper Surinam, Marowyne, and Saramacca rivers, and certain tributaries of these great streams.

The Negroes of North America, as well as those of the West Indies and other territories in this hemisphere, have cast off nearly all of their African heritage, completely yielding to the influence of white civilization, eager to immitate its customs and to emulate its standards.

The Djukas are of an entirely different mold. They still cling to a number of the African customs and crafts of their revolutionary forefathers. Many of the slaves who rebelled were born in the colony. On the other hand, the rebel forces contained a goodly sprinkling of recent arrivals from Africa, and although these slaves came from many different tribes, a number of customs and traditions were held in common. Under the patronage of their dusky leaders, the culture of the black men was welded and cherished and that of the white man deemed deeply inferior. This idea, in a modified way, holds even

at the present time. To the Bush Negroes the white man is not a superior being. They realize that "*buckra obeiah bon*" (white man's magic is good), but they are proud of their own, which seems to suit them much better. In a word, they have absolutely no sense of inferiority. On the other hand, many of the Djukas tend to regard the white man as a weaker creature. The Bush Negro's ability to take care of himself under jungle conditions is apt to make him look down on the white man, who is, in truth, at times relatively helpless without the Djuka's aid as paddler, hunter, or guide. On many of the rivers no progress into the interior can be made without their help.

The Djuka finds his own living. Game, fish, oil-bearing nuts, and a little fruit are furnished by the jungle; the land is fertile and, although a terrific battle must be constantly waged to keep out the ever encroaching jungle, as well as insect and bird pests, each village has its little provision ground, which furnishes cassava, yams, peanuts, and occasionally sugar cane and peppers. Curiously, the provision clearing is always situated at quite a distance from the village. Upon inquiring the reason for this, I was told that the custom of having the provision clearing so placed was a survival of the days of the rebellion for, when the white forces discovered a rebel village, it was usually destroyed, but the wily blacks would retire deeper into the forest, far beyond their provision ground, where they would rest in safety, and occasionally send scouts to the clearing for food.

Traders from the Dutch towns come up to the more accessible Bush Negro villages and barter for the hard-wood timber which some of the Djukas cut. While the necessities of these people are never controlled by the whites, the lumber, or the money paid for it, forms a means by which

A FAMILY GROUP—LOWER SARAMACCA RIVER
Very characteristically they wear amulets around their necks, designed to ward off some evil or to insure good fortune

THE APENTI OR SIGNAL DRUM—UPPER SURINAM RIVER
The design *motifs* are those of the snake and the notch. The snake *motif* is practically identical with a similar *motif* often occurring in the work of the West African natives

they can purchase shotguns, brightly colored cloth, brass wire coils, and tobacco. They also barter for axes, shot, powder, knives and other iron ware; for, while the Bush Negro deems it a disgrace to bring anything into the village that can be made by him, he is not averse to trading for the articles mentioned above. The bright cloth is used for raiment that is worn as a sort of toga. People clothed in this manner are to be found in many parts of the West African Coast. The brass wire coils are used for ornamentation, especially by the women, and are wound tightly about their arms and legs, a custom distinctly African in its origin. Far up the rivers, however, are communities few occupants of which ever come into contact with white men.

Their method of using tobacco is unique to say the least. Instead of smoking as we do, most of them prefer to suck up through their broad nostrils a dark brown fluid made by soaking the tobacco leaf in water, to which a little wood ash has been added. They offer to their guests a small vessel containing this liquid, as we would a package of cigarettes. The noise emanating from such a gathering is great, and I often wondered how the membranes of their noses and throats withstood the constant application of the burning substance.

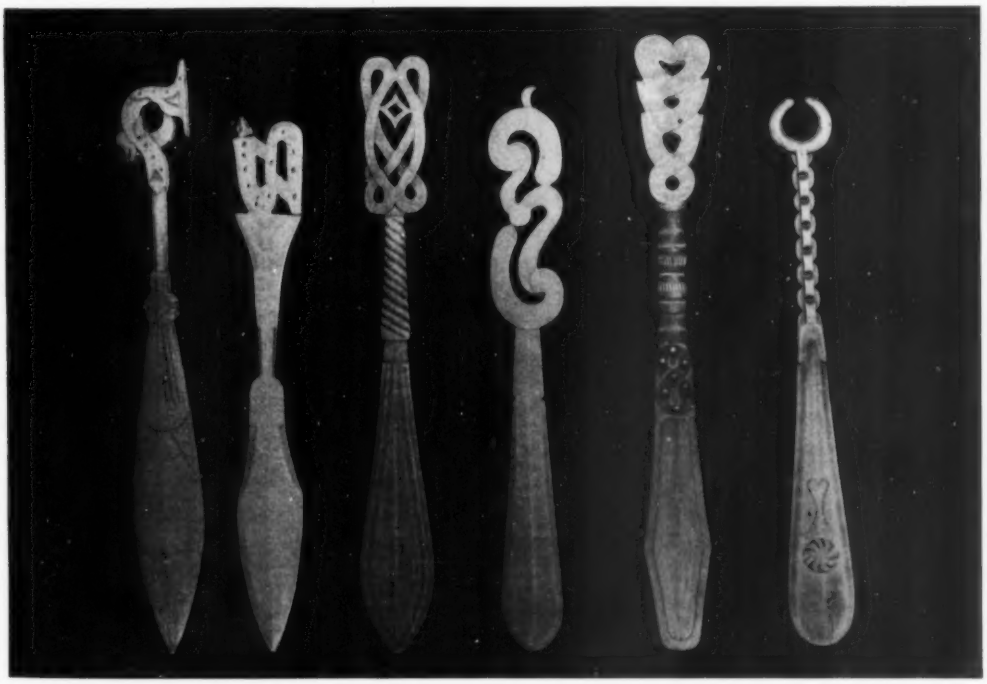
Besides the protection given them by nature, the Djukas' feeling of superiority is based upon a word of mouth record of their successful war for freedom. This has been maintained from generation to generation in a sort of saga in which the names of the leaders, the stories of the battles, the anecdotes of magic protection against white man's bullets, and the instances of individual heroism and cleverness have been preserved. The history is told in a literary or ceremonial language, which, so I am told, is composed largely of modified African words. It is noble speech, or "deepee talkee" (deep talk) and unintelligible to othersthan the Bush Negro. The cook on my little expedition, a Negro from the Dutch town, was entirely

unable to understand it. The common speech of the Bush Negro is "talkee talkee." This is spoken by all of the natives of Dutch Guiana save the aboriginal Indians, and even by some of them. It is a mixture of Dutch, French, English, and African words, with a dash of Portuguese for good measure.

Curiously, upon constant inquiry, I was surprised to learn that the Djukas have no memory or cognizance of Africa; their history, as far as they are concerned, dates from the rebellion, and they have no knowledge of their origin prior to that time. My chief paddler, Quacoe, had an African name of important significance. Although he was doubtless named in honor of the famous Bush Negro rebel chief, the name was originally that of a king of the Ashanti people on the West African Coast.

Another remnant of culture strongly suggestive of the dark continent is the highly developed system of drum telegraphy found among the Surinam River Djukas. Besides the call "white man comes," I have heard others which were interpreted to me as "come quick, sick" "call the Gran Man" (captain) "come to the meeting," etc. Some of the natives use the drum upon which to talk to their "Gran Gadu" (great spirit), feeling that the throbs of the instrument are more likely to reach their celestial destinations than mere words or thoughts. News of one's arrival is anticipated in the same way by this tom-tom code, and if the visitor has made a bad impression, this negative report is well known up the river. In this case the blacks will refuse to trade or assist the offender, and uncomfortable indeed is the plight of one so greeted.

In many parts of Africa one finds the



ELABORATELY CARVED WOODEN STIRRING PADDLES
Like every other implement or utensil in constant use, these food paddles are decorated with the traditional patterns

FASHIONS IN COSTUME ON THE MIDDLE SURINAM
The cloth of which these highly original garments are made comes through traders who operate along the rivers

curious custom of skin decoration by cicatrization. This practice is found widespread among the Djukas. A number of incisions are made into the flesh of the face, arm, back, thigh, or abdomen, with a sharp knife, and into these cuts finely ground charcoal is rubbed. The wounds are arranged so as to form a design of geometrical proportions and, when healing is completed, these form a pattern of scar tissue welts. This custom of decoration is common among the women, and few have any claim to beauty without a pattern cut at one place or another upon their anatomy.

The Bush Negroes in the upper reaches of the rivers are deathly afraid of the French incorrigibles, and justly so; for these convicts, who escape from time to time from the penal colonies in adjacent French Guiana, in their desperate attempt to gain freedom by the overland routes through the forest, have, so I am told, attacked Djuka villages, murdered men, ravaged native women, and stolen provisions, thus making themselves formidable enemies of the black men. It is said to be the custom among the more remote villages to shoot these convicts on sight when encountered, and many harrowing tales seep down from the far interior, of fierce and bloody pitched battles fought in the eternal twilight of the jungle or along the swift streams, for the Djuka first and last protects his own.

The artcraft of the Bush Negroes is by far the most outstanding of their many interesting characteristics, and certainly makes an indelible impression. As far as my limited experience will allow, I must say that I do not know of any existing aboriginal people in the Western Hemisphere in whom the artistic impulse is more highly developed, or among whom artistic ability and attainment play a more important part in the social structure. While collecting specimens of their wood carvings for the American Museum of Natural History, I found that they were not at all anxious to part with these implements, and finally traded with me only because I offered an exceptional inducement, and because my guide explained that

I had come a long way and that the products of their craft were to be greatly admired.

On the middle and lower Surinam River I found that money and leaf tobacco were the chief means by which trade could be effected, but as I journeyed farther back into the interior on the Surinam, the value of the "guilder" decreased and that of tobacco increased until, finally, in the more remote villages, toward the end of my trip, the leaf was the sole means by which any trading could be done. After many unsuccessful attempts, I finally secured the most highly prized of all of their possessions, the elaborately carved telegraph drum or apenté, and then only because its owner had been lately ostracized from his village and traded with me for provisions. However, one young lady voluntarily gave me a bracelet of delicately filed iron because, as she claimed, my eyes put her in mind of those of her husband, lately deceased, so it may be inferred from this incident that sentiment is not entirely absent among them.

The man who is able to carve in wood artistically is looked upon with high favor by the women of the tribe and is also respected by members of his own sex. Of course, the ability to hunt, fish, and successfully provide for a family are qualities essential in every young man seeking a mate, but these are widespread and almost taken for granted, for there are few Bush Negroes who cannot hold their own on the game trails or along the swift rivers.

By the same token, many of the men are able to make these wonderfully artistic wood carvings, and the women seem to require that their households be provided with implements of a highly decorated nature. Sloppy or careless artistry is, so I am told, taken as additional grounds for divorce (a divorce being easily acquired by women in any event).

Thus the Djuka men decorate practically every implement which is used in the daily life of the tribe. Small wooden paddles made simply for stirring cooking food, are, as may be seen from the accom-

AN AID TO BUSY MOTHERS

The baby is carried on the mother's back, face forward, with feet straddling her waist, and is held firmly in position by a wide band of cloth tied around her body

CLEARING IN A BUSH NEGRO VILLAGE—UPPER SURINAM
The four-walled huts, with low, overhanging, thatched roofs that successfully shed the heavy tropical rains, surround the clearing, though in no fixed positions

panying illustrations, highly and artistically carved in one or more of the traditional designs. Graceful canoe paddles, especially those which are used by the women, are similarly decorated. The low stools and benches upon which the natives sit truly call for superb efforts on the part of the wood-carving artist. Combs used for combing their kinky hair, which are not even worn as ornaments, the small, low tabourettes which serve at times as tables, the calabash gourds which are used for plates and spoons, are always splendidly decorated, delicately and symmetrically designed.

Experienced ethnologists who have made a special study of Negro art—Gerhardt Linbloom, and others—have arrived at the conclusion that this art work and the *motif* displayed, though now modified to some degree, are very probably a survival of the African heritage.

Linbloom states that the snake *motif* shown so often in Djuka carvings is very closely related to designs of the same character found among the tribes of African Guinea and Dahomey. Other units of decoration he has been able to trace to the Ashanti and Benin people. The wooden combs, with their gracefully pierced ornamental work, are an almost unaltered remnant of African origin, as they are being made and used today by the Negro tribes in the northern part of the Ivory Coast Colony and other regions of Africa as well. Specimens of these combs taken from many parts of Africa may be found in the collections displayed at the American Museum but, curiously, they are not as delicately wrought nor as symmetrically carved as are those made by the Djuka artist in the South American jungle, four thousand miles and two hundred years away from his fatherland.

Many other instances could be given to show how closely related to West African art is that of the Bush Negro, especially to that found on the Gold and Slave coasts and in the Cameroon. The districts mentioned are among those from which

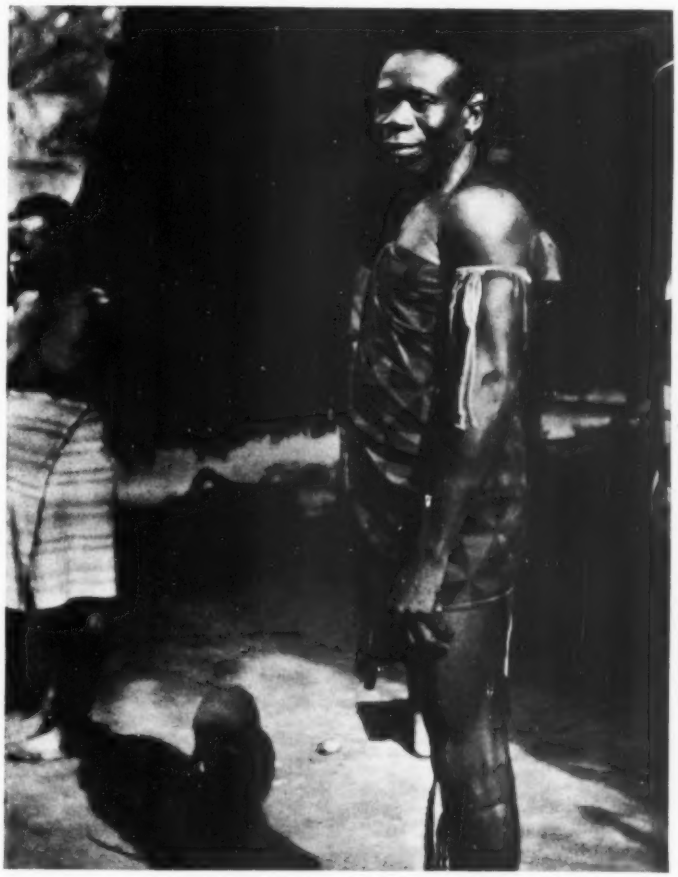
large numbers of blacks were shipped to the Americas and in all probability the similarities are not accidental. Further, the snake designs which occur so often are religiously emblematic for the Bush Negro and likewise in West Africa, where at Dahomey and Whydah, whence came so many thousands of slaves, snake worship has one of its principal centers.

When one considers that the tools used by the Djuka wood carver are cheap trade knives and dividers, and that the smooth finish is usually accomplished by the use of a mat of grass dipped in fine river sand, one cannot help but be amazed at the beauty of the workmanship.

If space permitted, many interesting things could be told of the rebellion, and of the religion, medicine, and government of these people; how they believe in a supreme God, a ruling spirit over all things but, besides, have a number of minor deities such as the alligator, silk-cotton tree, and a type of boa constrictor that accompanies their voodoo ceremonies; how they allow their dead to remain for days in the tropical heat before burial. Much could be said of their obeiah priests and witch doctors, of their famous snake-bite cure made from the roasted head and tail of a venomous snake. This concoction is highly prized even in Dutch towns and is believed by many also to have the power to turn poisonous reptiles from one's path.

Then there is the sacred medicine city of Dahomey (pronounced "Daumay,") far up the Surinam River. White men are not permitted to enter it, for it is thought that the god who hovers over this sacred precinct would be offended at their presence. Here the seriously ill are brought from near-by villages and ministered to by special witch doctors. It is said that miraculous cures are often effected.

One cannot close without a word concerning the benevolent rule of the highly



BUSH NEGRO MAN OF THE LOWER SARAMACCA RIVER

He wears the abbreviated toga-like garment which is put on only when strangers are present or when he is visiting an alien village. This upper drapery, which is also worn for ceremonial occasions, is usually a patchwork of brightly colored pieces of cloth covering the right shoulder and leaving the left shoulder bare. Ordinarily, his only clothing is a breechcloth held in place by a string around the waist

A WITCH DOCTOR'S HOUSE—UPPER SURINAM RIVER
Medicine and its ceremonial accompaniments are the prerogatives of the Djuka witch doctors who, in their healing, use roots, herbs, nuts, etc., gathered in the jungle

efficient Dutch authorities, who give these black children free range of the rivers and jungle and treat so kindly their "Gran Gran Man," or river king, when he comes down annually for counsel with the Governor at Paramaribo, and lastly of the Djuka's great courage and his splendid work as a river man, in his frail dugout canoe, completely mastering the mighty streams and fierce treacherous rapids. The Djukas are a proud people, deserving admiration and respect, and a people well adapted to their environment.

I wish to acknowledge my deep appreciation for the aid furnished me by E. W. Rogalli, Chief Forester, Mr. J. W. M. Strang, and Mr. Alexander Wolff, of Paramaribo, without whose advice and assistance my little journey would have been impossible.

A MODERN "MEDICINE MAN" IN CHINA

A Herpetologist from the American Museum Collects Lizards, Frogs, and Snakes in Fukien Province and Finds Them Admirable Creatures

By CLIFFORD H. POPE
Assistant Curator of Herpetology, American Museum

THAT the farmers of Fukien Province had no conception of my real reasons for collecting frogs and snakes and lizards was obvious enough. But because the Chinese use these creatures for medicine and because, for a thousand years, Chinese "medicine men" have gone about collecting them, the tea pickers of Fukien merely imagined that I was another "medicine man" gathering cures for my people beyond the sea. I did not always try to correct the idea, for they were willing to bring me specimens for such purposes and I was not sure whether they might object if they learned that my reasons were far different. So it was as a "medicine man" that I studied and observed and collected, and the tea pickers about my laboratory accepted me as such.

On one occasion a crowd of these people gathered about me in a circle around a pile of decaying bamboo waste high in the wild mountains that separate the provinces of Fukien and Kiangsi, while I, with the help of one or two of the onlookers, was photographing a small, brown pit viper that lay beside a batch of white eggs in a small cavity in the mass of waste. The snake tenaciously guarded its eggs against all odds, refusing to budge an inch until the eggs had actually been removed. Only then did it try to escape. Anyone would have been impressed by this display of reptilian courage. However, its only reward was an alcohol "grave" in a museum's study collection.

On another occasion a harmless water snake (*Natrix percarinata*) was brought in with a lot of eggs. The snake remained quiet as long as it was near the eggs, and when put in a tin can with them, it coiled itself about them and did not try to get away. Ordinarily, when captured, this species is terrified and makes violent efforts to escape.

Snakes do not deserve the reputation of being slimy and ugly and cowardly. On the contrary, they are not only clean and beautiful and graceful, but courageous as well. Some kinds, it is said, even protect their young by swallowing them in times of danger, but there is no positive proof that this is true.

Fukien Province has a widely varied snake fauna, no less than sixty species having been recorded from there. By far the greater number of these are harmless, though some of the deadliest and most dangerous of snakes, such as the cobras, are on the list. The giant among the Fukien snakes is a python which, it is said, attains a length of more than twenty feet, while the tiny wormsnake (*Typhlops braminus*) represents the other extreme. The wormsnake could easily be mistaken for an ordinary earthworm and is often found in flower pots. Neither one of these two extremes of size possesses a poison apparatus, so both are really harmless, though the python is not devoid of strength. It has the reputation, however, of possessing much greater crushing power than it actually has.

In killing its prey the python strangles rather than crushes. Once it has coiled itself about an animal, the snake tightens its grip firmly about the struggling body at each successive expellation of breath. As the efforts to breathe become more and more spasmodic, the victim quickly loses strength and suc-

FOOCHOW, CHINA

This city was, in the days of the clipper ships, one of the leading ports in China. Since the decline of the tea trade, however, it is no longer important in foreign trade. The famous "Bridge of Ten Thousand Ages" can be seen in the distance

cumbs, though the python has really done little more than hold the ground that the animal has unconsciously given it. Thus, Nature has given the python a labor-saving method of overpowering its prey. It practices the principle so well understood by the jiujitsu wrestler who merely helps an opponent to overcome himself. It is doubtful if the python has sufficient strength to crush the bones of a big mammal. It is also doubtful if one of these snakes would use its power of constriction in a purely defensive battle. More likely it would simply strike and bite in ordinary snake fashion.

Extremes in size among the poisonous snakes of Fukien, though not so great as among the harmless varieties, are nevertheless very marked. The pit viper that guards its eggs so bravely is less than two feet long, but the king cobra (*Naja bungarus*) reaches an enormous size and is, in fact, the largest poisonous snake found anywhere. A specimen eighteen feet long has been recorded. This giant snake ranges through China's southern provinces, where it enjoys the well-deserved reputation of being extremely dangerous. Mankind is not alone in its fear of this terrible creature, for it preys upon other snakes which are said to form a large part of its diet. Cannibalism is not practiced by man alone!

Elaphe carinata, a big, harmless, black and yellow snake common over a large part of China, proved itself a first-class collector, securing for us a new variety. One day two of us were out hunting in a bamboo forest, when we heard a noise on the trail ahead. We hurried and arrived just in time to see a large *carinata* tumble across the narrow trail and slide down the steep mountainside below—a most peculiar performance

for a snake. It seemed to have lost its footing. Following, we soon found it hidden among the rocks. It looked rather too plump. We felt of its body and were convinced that it had just finished a meal, so we squeezed its stomach. Out slid the interesting new variety in perfect condition. After being cleaned in the stream it was as active as if nothing had happened to it. Its devourer was none the worse for the experience, either. On another occasion my skinner removed from the stomach of one of these cannibalistic snakes two victims, one a half-grown viper and the other a snake actually longer than the devourer. Both, though dead, were yet undigested. This shows what an appetite *carinata* has. However, cannibalism among snakes is not very common for, from about a hundred species with which we worked in China, we secured evidence proving that only two species have developed the habit to a marked degree. Most snakes prey upon frogs, lizards, or small mammals, such as rats, mice, and moles. These are not chewed, but are swallowed whole. The lower jaws of snakes are connected by ligaments which, in stretching with the skin, allow proportionately enormous objects to pass.

A small *Pseudoxenodon bambusicola* was caught by one of my collectors near Yenping. In spite of such a formidable name the snake is harmless. It tries, however, to create the impression that it is quite dangerous. The little *bambusicola* behaved in a most astonishing manner when teased. It first flattened its head, neck, and body, to such a degree that the scales were widely separated on the stretched skin and its color pattern stood out vividly. This maneuver failing, it inflated its body and even drew its lips up so that it appeared to be "snarling." When further annoyed, it opened its mouth and struck, but not in a convincing

A PEACEFUL SCENE ON THE RIVER MIN

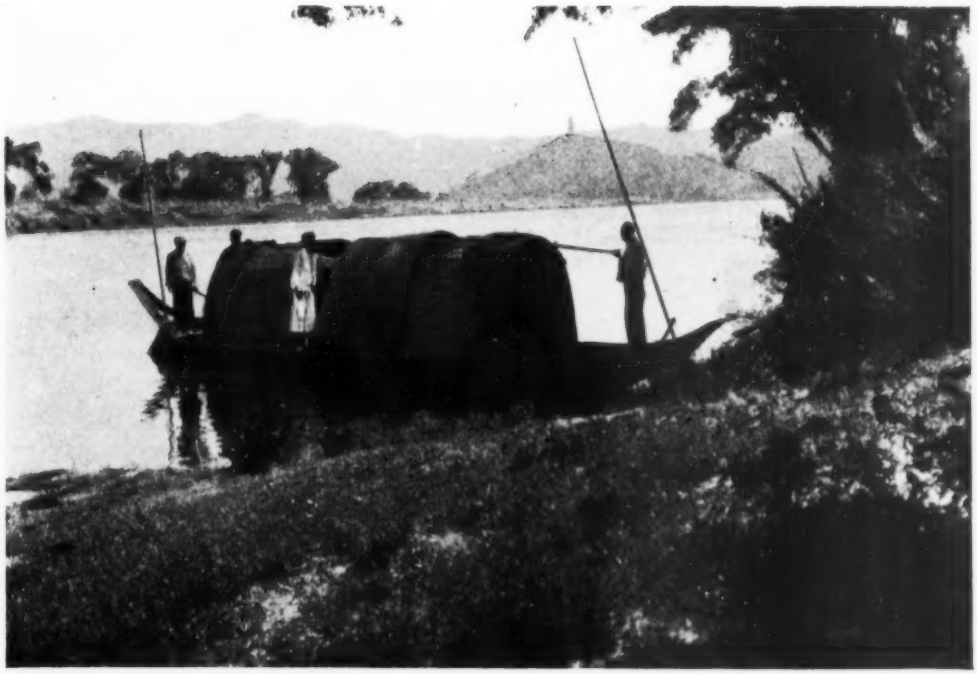
Off to the right great numbers of boats may be seen packed closely together. Hundreds of people make their homes on these boats and seldom venture ashore

THE VILLAGE OF "SEVEN MILE BRIDGE"

Mr. Pope's headquarters were three miles down the valley from this group of houses. It was among these Fukien mountains and valleys that he collected his specimens

PREPARING TO CROSS A RIVER ON THE FUKIEN PLATEAU

The raft seen in the foreground is made of six giant bamboos, and, because of its shallow draft, is especially useful on swift streams



A CAMPHOR-WOOD BOAT SPECIALLY CONSTRUCTED TO SHOOT RAPIDS
In this boat the party descended from the plateau of northwest Fukien to Kien-ning, which lies about 150 miles upstream from Foochow

MEALTIME ON A CARGO BOAT
Each man fills his bowl from a wooden rice bucket around which all squat as they eat their meal and discuss local news

ON A MOUNTAIN TRAIL

These coolies chose to carry about 125 pounds each, despite the roughness of the ancient paths. The trails are often very abrupt, and a misstep could easily precipitate the unwary person hundreds of feet into the valley below

way. In fact, it did not really bite. The whole performance was an imitation of the defensive actions of some of the deadly snakes. Finally, it tried turning on its back as if dead. This it did repeatedly. Was it "playing possum" with us? There is one American snake, the so-called "spreading adder" that uses this same trick but goes the Chinese snake one better. If, after it has feigned death, one turns it on its belly, it will immediately turn on its back again! Apparently its idea is that a dead snake lies only on its back.

One might almost say that such snakes have personalities. Of all my ophidian acquaintances, the one whose individuality stands out most vividly in my mind is the green bamboo viper (*Trimeresurus*) of southeastern Asia. In the mountain form the entire body is leaf green except for an inconspicuous lateral line. Even though this snake is a true pit viper and possesses perfect hollow fangs, the bite is seldom fatal to man, although the venom would certainly make one very ill.

It was in the wild mountains of Fukien that this snake nearly brought about a division in camp. A local mountaineer strolled in one day carelessly swinging a fine specimen in one hand. Kang, my taxidermist, refused to buy it, contending that its fangs must have been removed in order to render it so harmless. I arrived just in time to avert a row by examining the snake and finding its fangs in perfect condition. The collector's feelings were so hurt by Kang's behavior that he refused to sell the snake at any price, and departed. He returned later, however, fully recovered, and explained to us that these vipers, if handled gently, are so docile that there is no great risk in carrying them around in the bare hands. This time he brought with him no fewer than ten, and proceeded to drape them over pegs and clothes lines, declaring that they would "remain hanging over night." They actually were reluctant to drop to the ground, so his statement was true to a

degree. In spite of all this, I have seen individual vipers that would strike viciously at any object brought near them, although it may be that they do not bite anything actually in contact with their bodies—a hand for instance.

One night I was attracted by a strange frog call coming from the side of the stream up which I was working. There was nothing to do but sit and wait, for every time I went toward the sound, the call stopped. After some time of fruitless waiting I looked down and saw a tiny green viper approaching. It drew near but finally stopped and lay on a twig quite motionless. Wishing to verify its appetite for frogs, I took one from my bag, tied a thread to its legs, and dangled it before the snake. The viper was not slow to act, it seized the frog in a wink, and devoured it forthwith. To my chagrin I found, a few minutes later, that the devoured frog was no less than one of two specimens of a new species I was carefully saving. It was too late to regain it, however, for the satisfied snake had already disappeared, little caring that it had eaten a "new species" out of the hands of one who had come half way around the world to secure it. In the meantime the author of the new call had become so alarmed by the strange proceedings that, though I waited from one o'clock to daylight, it scarcely stirred again, and to this day remains a mystery.

The green viper was only a visitor to the stream, but another snake, a drab-colored fellow with a small head and body, was a real cascade inhabitant. It is called *Tapinophis latouchi*, after Mr. J. D. La Touche, its discoverer and the second collector to visit this region. *Latouchi* has adapted itself to life among rocks and gravel through and over which cold, clear water pours. There it burrows in search of earthworms. Prolonged exposure,

GATHERING POISONED FISH

Since time immemorial these mountain people have caught fish by poisoning the streams. A vegetable poison is used, and the effect is very rapid, but fortunately it is not very far-reaching]

A VIPER ON ITS NEST

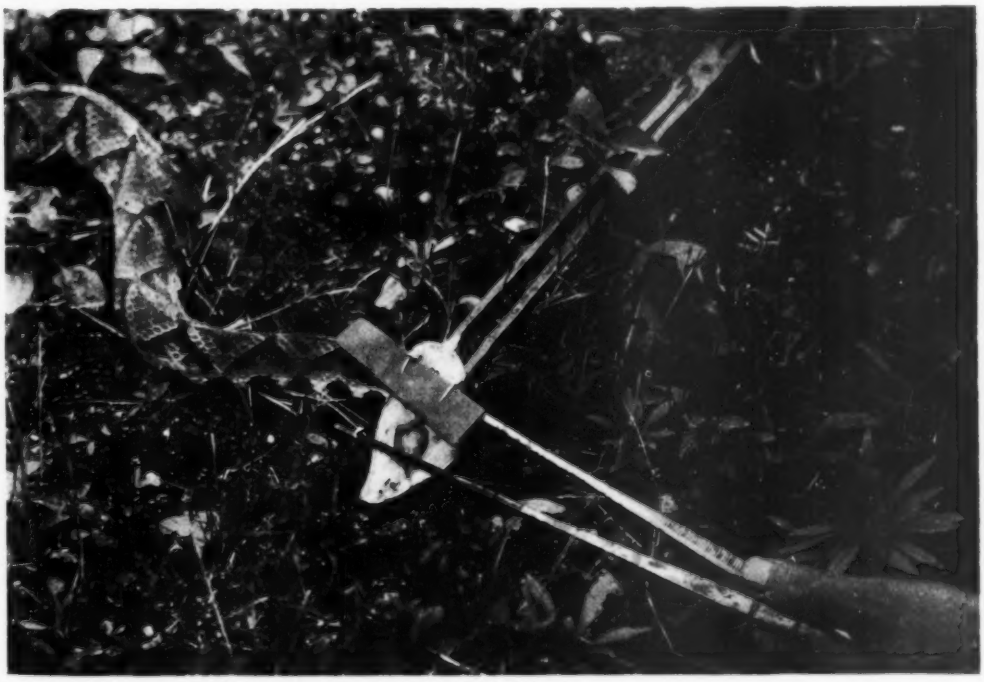
This snake tenaciously guarded its eggs against all odds, refusing to budge an inch until the eggs had actually been removed

A LEGLESS LIZARD

This "glass snake" is not a snake at all, but is, instead, a lizard without legs. It, too, lays eggs, but unlike the viper, takes flight when it is disturbed on its nest

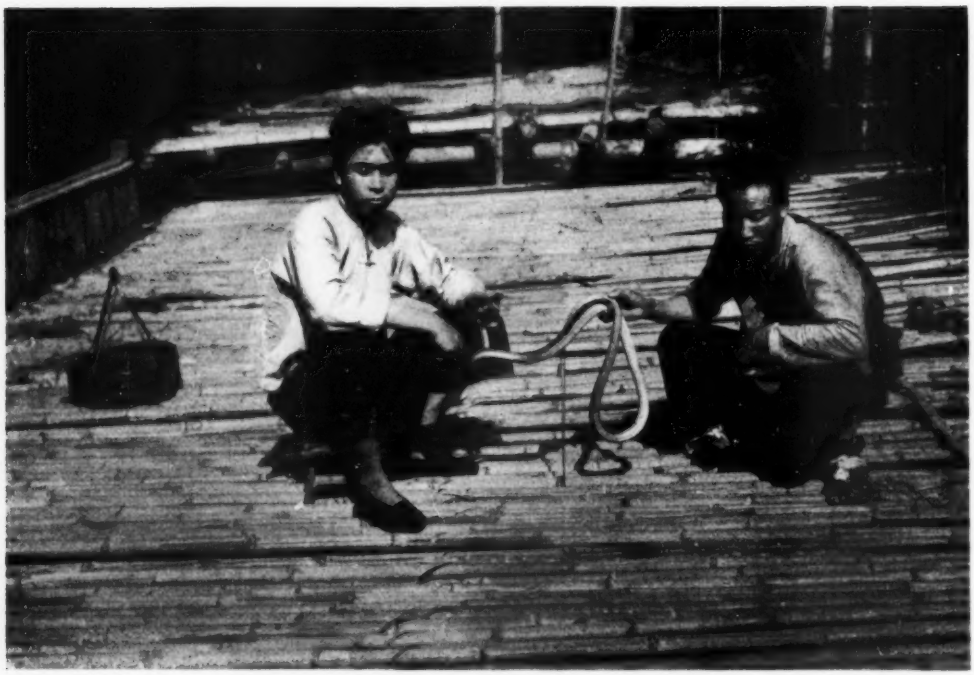
A SNAKE'S EGGS

Each of these eggs is about the size of a small plum. This nest was found by twelve-year-old Ming Fa, who also caught three large snakes near by and brought them to Mr. Pope alive and uninjured



THE HOLLOW FANGS OF A PIT VIPER

Despite its dangerous armament, this reptile is of a docile nature, and is not given to unprovoked attack



PREPARING A SPECIMEN

Yu Fa, collector, and "Young Tang," reptile preparator, are shown about to skin a good specimen. The largest snakes were skinned rather than preserved entire

however, to ordinary air temperatures invariably brings on its death. It is a night prowler and must be dug out during the day. This snake is timid and does not defend itself, save by the production of a mildly offensive odor.

I have often been asked how one avoids being bitten when hunting snakes in a country inhabited by both cobras and pit vipers. The answer is simple. Although we secured in Fukien during our sojourn of a year and a half approximately 1500 snakes representing about 55 species, and though I frequented the most snaky places I could find during eight or ten hours of every twenty-four, it is doubtful if I personally encountered a dozen poisonous snakes. Practically all of those I saw were sluggish pit vipers and only once was I in a precarious position in relation to one.

On that occasion I happened to be looking for frogs in a field, when my trousers almost brushed the upturned snout of a huge pit viper (*Agkistrodon acutus*). The snake, though coiled, did not strike. This is a typical instance of reptilian manners and decency. My guide, a twelve-year old Chinese boy, saw the snake and called me back, but he was very indignant with me when I helped catch it, for he feared that my interference would jeopardize his reward.

All of the Chinese farmers assumed that we carried vast stores of medicine that would instantly cure the bite of any creature. This was most unfortunate, for these trusting souls handled deadly reptiles with the utmost carelessness, and I had no good medicine whatsoever with which to cure snake bite. A man once brought me a cobra with which he had walked five miles over the mountains through a hard rain. He also brought a note from a mutual friend, telling me that the snake had bitten the fellow and imploring me to cure him. He had, however, already cut

away the flesh from around the wound and cured himself. The actions of these folk are in strong contrast to those of a Virginian of my acquaintance, who, though living in a region practically free from venomous reptiles of any description, had for two score years avoided grassy fields and meadows for fear of being bitten by a snake!

If one will only stop to consider snakes as they deserve to be considered, it is easy to see that they are fascinating creatures full of popular as well as scientific interest. When we study birds or mammals we do not hold against them the fact that here and there we find an objectionable or dangerous species. As a matter of fact, with mammals, the more dangerous one of them is the more certain he is to attract attention. Why is this not true of snakes? By far the largest percentage of them are not only harmless but are, in addition, friends of man. Yet we go about with the fear of snakes in our hearts and with superstitious notions of snakes in our minds, with the result that we rarely get acquainted with them and, of course, learn very little indeed about them.

The study of the behavior of snakes is only in its infancy, and much remains to be done in that field. Thousands of people, these days, entertain and instruct themselves by taking bird observation hikes and outings. Why should they not combine the study of reptilian and amphibian life with their other observations, or why should they not carry on such observations alone? Unfounded fear and silly superstitions undoubtedly interfere, but once they are free of such handicaps—as many observers agree—the way is open to a new and a fascinating field of study and entertainment.

YU FA'S SON POSING AT THE DOOR OF A TIGER TRAP

Wisely, the Chinese tea-grower builds his tiger trap as an annex to his pig pen. Thus the pig serves as bait, but lives in safety the while

INSECTS THAT ERECT TENTS

The Problem Presented by the Tent Caterpillar and Nature's Method of Controlling Its Numbers

By FRANK E. LUTZ
Curator of Insect Life, American Museum

THERE is a moth which, while still a caterpillar, joins with its young brothers and sisters in constructing a silken tent that forms a community dwelling. You have all seen the tents of this species (*Malacosoma americana*), and during the past several years many of you have either gathered or encouraged others to gather and destroy the over-wintering egg masses. I wish that I were more certain whether such destruction is wise or at least worth while. I shall presently say why the doubt has arisen, but apparently there was none in my mind about ten years ago when I was writing the *Field Book of Insects*. A paragraph there starts out appreciatively enough:

> If the tent caterpillar were not so common and such a pest, we who are interested in Nature would be willing to go miles to see a colony. We might even bring eggs home so that we could have it in our garden.

But it ends in dull pessimism:

> Considering that Nature helps us by giving this species many enemies, that the larvæ gather in all too conspicuous webs where we may conveniently burn them, and that even the eggs may be easily seen and removed during the winter, it is strange that people allow *M. americana* to exist. The reason probably is that its extermination requires community action. Last winter I picked all the egg masses off my trees; in the spring the editor of our country paper published a long article telling how to combat the tent caterpillar; he lives across the street from me but he did nothing to the big colonies on an old cherry tree in his yard because he was going to cut the tree down in the autumn; this winter I must go all over my trees again.

Several years later I wanted to get a few egg masses for a certain purpose. There were none in our yard or even in the editor's. I scoured the neighborhood and went to the edge of town, where there are plenty of wild cherry trees, without finding enough to have made the trouble worth while. What had happened? I am not sure; but this species is a native of America and, during its centuries of residence here, it has become so fitted into its environment that a "balance of nature" exists. The beams of this balance are not stationary; they swing through such a wide arc that at one time the species seems about to eat up all vegetation (despite the fact that it really eats but few kinds of leaves), and at another time an experienced entomologist must hunt long to find only a few of its conspicuous (when present) egg masses; but swing it does. We can be certain that "it is darkest before dawn." Just as truly, of course, it is lightest before night-fall, but that isn't usually mentioned.

When the tent caterpillars, or "webworms," become very abundant, Nature, without help from her human species, does something that reduces their numbers. Then she lets up a bit, and the caterpillars, or "worms," become abundant again. The crests of the waves are ten or a dozen years apart. If you prefer the other metaphor, it takes about that long for the balance of nature to make a complete swing in this instance. Just at present the caterpillars are on the down grade, and last year, at our Station for the Study of Insects near Tuxedo, N. Y., Mr. F. M. Brown found that one probable cause of the decrease is the presence of what was then an undescribed bacterium attacking the eggs. Such being the case, when you

collected and burned the egg masses, you also collected and burned one of Nature's agents in maintaining the balance between species. Was that wise? I do not know. Perhaps you were helping Nature, but I almost doubt if it was worth while, since Nature was doing a fairly good job by herself.

One thing that we may eventually be able to do is to learn how to use in our own interests the agents which Nature uses. If, when her parasites of plant-eating insects are so abundant that they are dying out for want of food, we could keep them going and let them loose as we need them, much would be gained. It would be like collecting water in a reservoir to be used for irrigation during the dry season. It is one of the many tricks that we still have to learn in our attempted control of those particular insects that injure us.

If we wish our collecting of tent caterpillar egg masses to do the most good, we should collect them during the years that the wave of abundance is low or rising, not in the years that it is at its crest or falling. However, like the celebrated house owner, we do not pay much attention to the roof when no rain is falling.

There is another thing involved in these decennial excitements about the tent caterpillars. The adult moths eat nothing at all. They emerge in midsummer, mate, and each female capable of doing so lays a broad band of eggs around some twig, covering the eggs with a fluid that hardens into a weatherproof varnish. Then the adults die and their offspring do not hatch until the following spring.

The female lays her eggs around some twig, but she does not lay them around just any sort of twig. Almost always, although it may not seem so to the owner of apple trees, she selects a cherry twig and apparently strongly prefers a native, or "wild," species of cherry. Like dutiful children, her offspring eat what is set before them, and, since that is usually wild cherry, the damage they do is largely confined to wild cherries, among the least valuable of trees to man, however much certain birds may enjoy the fruit.

A natural and often-made suggestion is that, if we get rid of all of the wild cherries, we shall deprive the tent caterpillars of their favorite food, and we shall not see so many of their tents. (It seems that the unsightly appearance of the tents disturbs many people more than seeing the leaves being eaten.) Such destruction of wild cherry seems almost like burning down a barn to get rid of the rats, but leaving its feasibility and desirability out of account, I fear that all that it would accomplish would be to force the mother moths to change their egg-laying habits and concentrate on, say, apple trees—the rats would move from the burning barn to the house.

Photograph by M. C. Dickerson

A FAMILY TENT

"If the tent caterpillar were not so common and such a pest, we who are interested in Nature would be willing to go miles to see a colony"

How the mother moth chooses the twigs upon which to lay her eggs is really a mystery not easily to be dismissed by saying that she uses her sense of smell.

Photograph by M. C. Dickerson

EATING, GROWING, SPINNING

These are the tasks which Nature gives a caterpillar. Are these tasks done by instinct or by intelligence or do we need another word?

If she does choose by odor, is it the smell of the leaves or of the twigs? Last year I made a large cage in which I put dozens of moths. At one end of the cage I put wild cherry twigs without leaves and surrounded them with leaf-bearing twigs from various other trees. The wild cherry twigs were of the diameter usually selected by the moths but the other twigs were either too large or too small. At the other end of the cage things were reversed. The vase there contained leaf-bearing wild cherry twigs too thin to suit the moths, and in among the leaves were twigs of the right size but from other kinds of trees. If the mother makes her choice on the basis of bark, the eggs would be placed on the leafless wild cherry twigs in the first end of the cage; if on the basis of leaves, they would be on some alien twig among the wild cherry leaves at the other end of the cage.

I was quite excited. It was a beautiful experiment; but it didn't work, because only one somewhat deformed egg mass was laid, and one egg mass, deformed or otherwise, did not seem sufficient to establish such a point. The trouble seemed to be another one of Mr. Brown's undescribed bacteria, this one attacking the egg-producing apparatus of the female moths. They were too sick to lay eggs. If so, that is another way in which Mother Nature swings her balance back. The idea is somewhat confirmed by the fact that there were very few egg masses in this general region last winter, even where school-children did not pick them at so much a hundred. The result so far as I am concerned is that I must either wait six or eight years before I can repeat the experiment, or I must go to some part of the country where the tent capterpillars are riding the crest of their wave instead of being on the down grade.

At any rate, we know that the mother of tent caterpillars, like other mother moths, can do more than we can. In the dark she can select out of a whole forest of mixed trees a particular kind of tree. It is the kind upon which she fed before she changed from a "worm" to a pupa and then from a pupa to a moth. In the case of *M. americana* only a few weeks elapse

between the last larval meal and the emergence of the adult to lay eggs, but many moths spend months as dormant pupæ enduring the cold of winter. When they finally emerge, do they still remember the sort of food they had eaten the previous year and before the two great bodily changes that took place since last they ate? If so, what do they remember? Surely it is not taste that guides them, for they not only do not fly around tasting leaves until they find the right kind, but adult moths could not eat leaves if they tried. Even when they have functional mouths, they can do nothing but suck fluids. If not taste, what? We run through the few human senses and conclude on the basis of them that she must hunt out the tree by smelling. Possibly we are right, but we must remember that we have still much to learn about insects, and that, if our noses were just a wee bit poorer than they really are, we would not know what smelling is, and so would not think of it.

This discussion reminds me of "instinct," a most convenient word to use on certain occasions. The tent caterpillars' mother selected wild cherry by instinct. It was instinct that led her to fasten her eggs in a bandlike mass around the twig and to cover them with a weather-proof varnish. The eggs develop before cold weather so that the young caterpillars are ready to hatch, but it is instinct that keeps them from bursting the protecting eggshell until early in the next year, when there are fresh young leaves to be eaten. It is instinct that holds the new-born family together and teaches them to build a communal tent out of their saliva. It is instinct that changes their gregarious habit when the larval stage is nearly completed and drives each caterpillar its own way. It is instinct that helps the wanderers to find safe nooks in which to spin cocoons.

Photograph by Frank E. Lutz

TENT CATERPILLAR'S COCOON

Opened to show the mummy-like pupa—a live "mummy," for in it a caterpillar is changing to a winged adult

When we cannot explain the action of an insect in any other way, we call that action instinctive, although other terms sounding more learned but explaining no more have been invented for certain actions. For example, when the full-grown caterpillar stops feeding and climbs down the tree trunk, it does so "because it has become positively geotropic." This means exactly what it says— and no more. The caterpillar "turns toward the earth." The caterpillar is also "thigmotropic"; in other words, it turns toward contact with solid objects, as much contact as it can get, and, when satisfied, it stays there to spin a cocoon. This, combined with "negative phototropism" (turning away from light) at that particular time explains why cocoons are made in hidden nooks. But does it? Have we really explained anything or have we merely described the caterpillar's action in fine-sounding, learned-looking terms?

As to "instinct," I pleasantly spent a part of one Sunday afternoon reading a noted psychologist's essay on mental

evolution in the light of modern knowledge. He says that at a given stage

> .... two possible courses lay open, by either of which a nicer adaptation to a greater variety of objects and conditions of environment might be achieved. One of these lines was the greater specialization and differentiation of the instincts, the innate mental dispositions, the racial mental structures, which express themselves in instinctive behavior. The other line was the increase of intelligence, or power of adaptation of instinctive reactions to the varying circumstances under which they are evoked. In the main the evolution of the higher insects followed the former line; that of the vertebrates followed the second course. This divergence gives some plausibility to Professor Bergson's sharp separation of instinct from intelligence. But M. Bergson has, as it seems to me, very seriously overstated the distinctness of the two functions and the two lines of evolution. Instinct and intelligence are not two distinct kinds of mental function; they are rather two abstractions that we make by considering mental process in two aspects in turn. All mental process is both instinctive and intelligent; it is instinctive in so far as it is determined by innate mental structure; it is intelligent in so far as it involves adaptation to the particular circumstances of each occasion, circumstances not provided for in racial mental structure. The vertebrates, in developing along the line of intelligence, did not abandon their instincts. Nor did the insects, in acquiring more highly specialized instincts, cease to be capable of some degree of intelligent adaptation of instinctive behavior.

Fine. There is a young wild cherry tree at the back of our yard. I think that I shall let it support a family of tent caterpillars each year. Possibly some day a psychologist will discover that they are almost human, either because their actions are more intelligent, or human actions are more instinctive than we now believe, or that neither instinct nor intelligence is anything other than tropism. At any rate, these insects are interesting pests and they are native to this country.

MATING AND EGG LAYING

These are the main duties of adult moths. By what devices does the male find its mate, and the female select the proper twig on which to place her eggs?

NEW WORLDS IN THE MAKING

Facts, Theories, and Hypotheses that Explain, or Try to Explain, How and Why the Earth and Other Astronomical Bodies Were Formed

By CLYDE FISHER
Curator of Astronomy, American Museum

EVERYONE discovers the universe for himself, and after some observation of the apparent behavior of the heavenly bodies, one begins to wonder about their origin. There is abundant evidence that the earth has not always been just as it is now. We cannot believe that the beds of coal, the deposits of sandstone and limestone and marble, the fossils in the rocks, and the Grand Cañon of the Colorado were created as they are. Even a superficial study of geology convinces one that "there is nothing unchangeable except eternal changeableness,"—that all of these and other features have undergone a long series of changes, that they have a life-story, if we can but read the record. The more we examine the worlds outside of ours, the more we are persuaded that changes have been going on throughout the universe.

Very early in our lives we notice that the sun rises in the east, passes across the sky, and sets in the west—surely one of our earliest astronomical observations—and to each one of us this seems as real as it did to our forebears of not many centuries ago, who believed that the sun went round the earth. Due to similar observations on the moon and stars, it was believed that the earth was the center of the universe.

It was not until the astronomers had made the important distinction between real and apparent motions, not until they understood that the sun was the center of our solar system, could any intelligent theory for the origin of these bodies be framed.

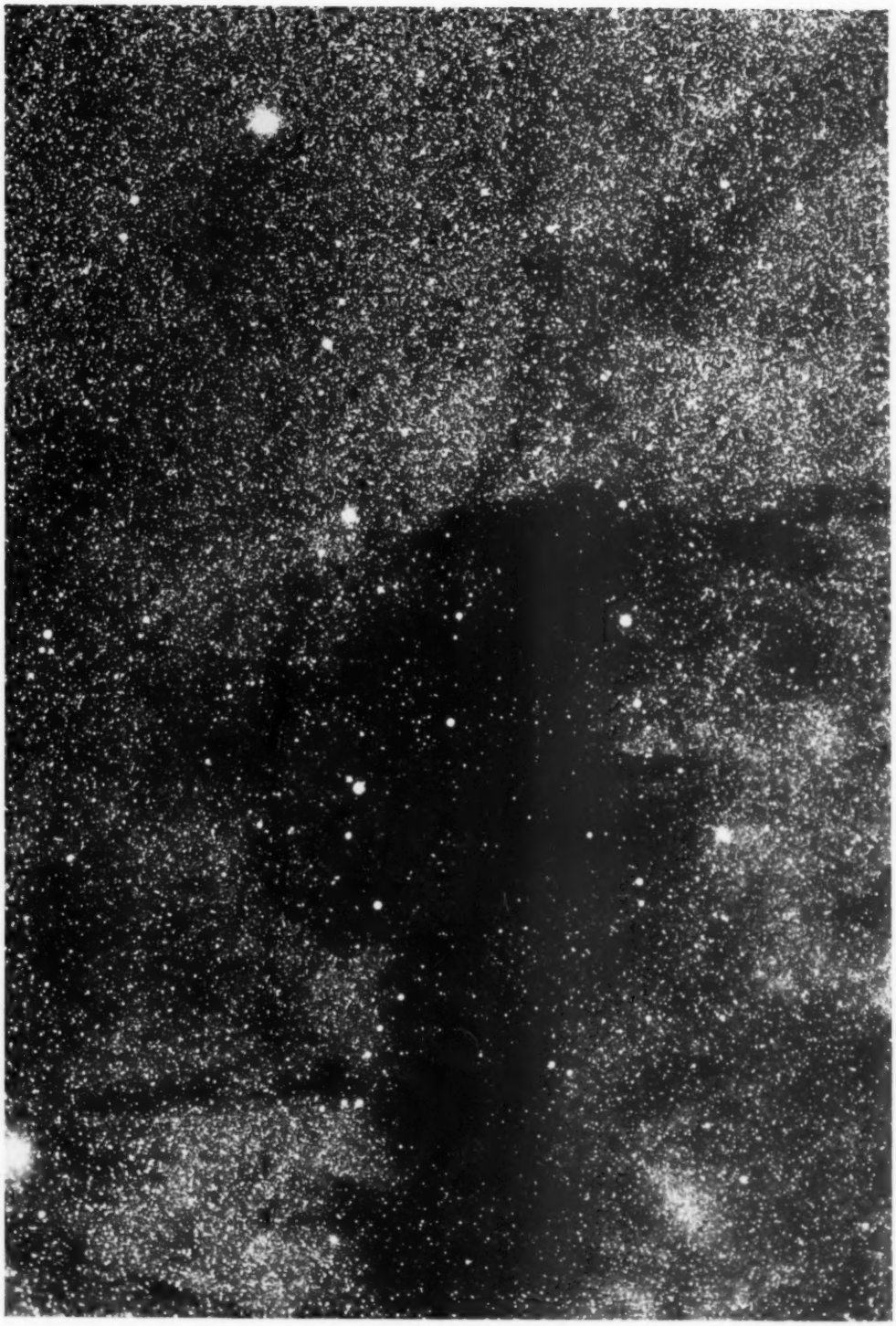
The first scientific theory of origin of our solar system, and it was a magnificent conception, goes back to the philosophers, Kant and Swedenborg. Since it was developed and put into scientific form by La Place, it was known as La Place's Nebular Hypothesis or Theory, depending upon the credence given. A hypothesis is more than a guess. It must have some evidence in its favor, and must not be contrary to proven facts. A theory must have more evidence in its favor, and a law is a theory proven beyond doubt. So, hypothesis, theory, and law are relative terms, there being no hard and fast lines in nature.

According to the Nebular Theory, the sun and all of the planets and their satellites and the asteroids were once a huge, rotating, gaseous nebula, which extended out beyond the present orbit of Neptune. As this nebulous mass cooled, it contracted, and, since we recognize no resisting medium in space, the speed of rotation increased. As the whole mass contracted, the circumference grew correspondingly smaller, so that the part at the surface went round more times in a given period. This increase in the speed of rotation was accompanied by increase in centrifugal force, or the force by which a revolving body tends to fly *from* the center.

So it was with the mass of the outer part of our theoretical nebula, and when this force had increased until it balanced

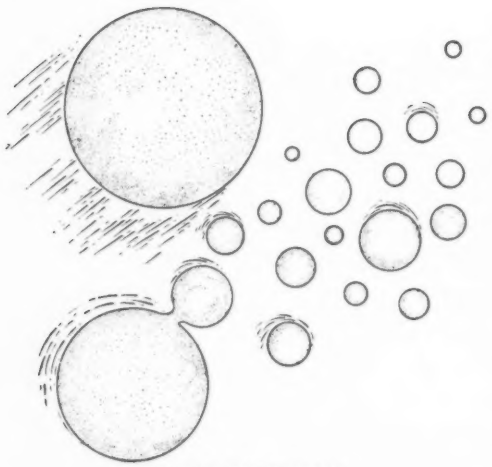
THE "NORTH AMERICA" NEBULA

This nebula, which bears a striking resemblance to the map of North America, can probably not be seen even with a telescope, but it can be photographed by a long time exposure. Photographed with 10-inch Bruce lens, by Barnard



PORTION OF THE MILKY WAY

Near the star Theta in the constellation Serpent-bearer (Ophiuchus), is a remarkable vacancy in the Milky Way, shown here as a dark patch surrounded by myriads of stars. Photographed with the Bruce telescope, by Barnard



A NEAR COLLISION

Diagram to illustrate the "dynamic encounter" between our sun, which is a star, and another star, at the birth of the planets of our solar system

the pull *toward* the center (centripetal force or gravity), then the inner part of the great nebulous mass contracted away from the outer rim or shell of the nebula. This rim or outer shell was not thrown off like drops of water from a grindstone or mud from a carriage-wheel, but was *left* balanced between centrifugal force and gravity, and still rotating. This rim or shell, which may not have been complete, or even uniform in thickness, was supposed to collect together in a more or less globular mass, according to the theory of gravitation by which every particle of matter attracts every other particle. Thus the outermost planet was formed, and in the same way the rest of the planets were successively formed, the one nearest to the sun being the last to be formed. In the case of the asteroids, or tiny planets which occur between the orbits of Jupiter and Mars, it is supposed that this shell, instead of collecting together in one mass, gathered together in more than one thousand small masses.

The moons or satellites of the planets were supposed to have been formed in the same way, after each individual planet-mass had been left balanced between gravity and centrifugal force, and still revolving around the central portion of the original nebulous mass.

As the nebulous matter condensed and cooled, it changed from gaseous to liquid form and then to solid, in the case of the four terrestrial planets, as Humboldt called the four inner ones, Mercury, Venus, Earth, and Mars. The four outer or major planets, Jupiter, Saturn, Uranus, and Neptune, still seem to present only an outer surface of cloud.

When the nebular theory was first conceived, it was thought that there were two kinds of evidence in its favor, namely: First, features in our solar system whose existence the theory would account for; and second, systems outside of our own which are now in phases suggesting the early phases of our own system.

Evidence of the first kind was most impressive, for it was thought the theory would explain the following conditions:

(1) The orbits of all the planets and asteroids are practically in the same plane (except those of some of the asteroids), which determines that these bodies occupy a narrow belt in the heavens only a few degrees wide. No planet is ever found near the North Star or even near the Big Dipper, and none is ever found near the Southern Cross, but all are always found in the narrow belt called the Zodiac.

(2) The orbits of all of the planets and asteroids are nearly circular (except for those of some of the asteroids).

(3) All of the planets and asteroids revolve around the sun in the same direction.

(4) The sun rotates on its axis in the direction in which the planets revolve, and its equator is but little inclined to their orbits.

(5) The planets of the greater density are nearer the sun.

(6) The moons or satellites revolve about the planets in the direction in which the planets themselves rotate

(except the eighth and ninth satellites of Jupiter and the ninth satellite of Saturn).

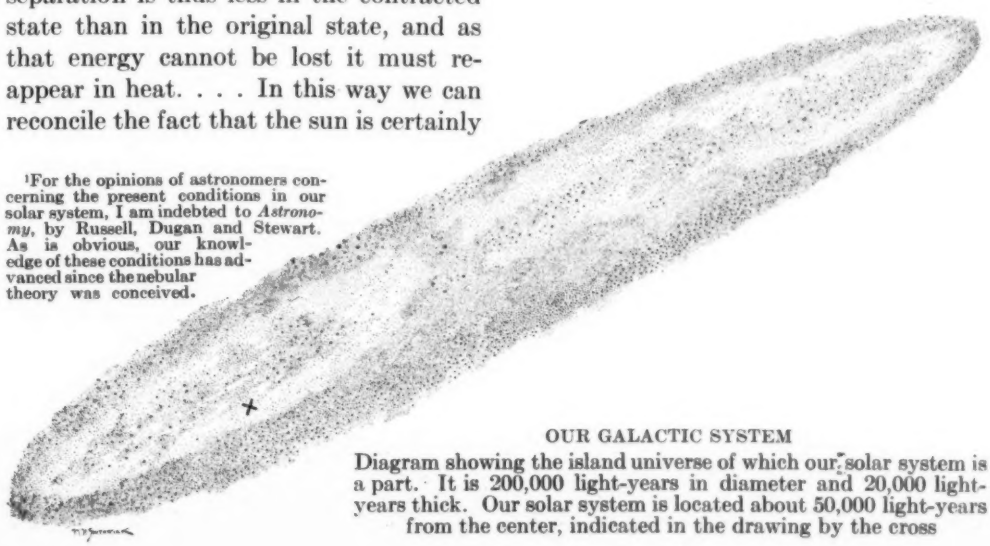
(7) The orbits of the satellites are nearly circular and nearly in the plane of the planet's equator (except for the eighth and ninth satellites of Jupiter and the outermost satellite of Saturn).[1]

It is not reasonable to suppose that such conditions as these are due to chance and therefore insignificant. If these relations were due to chance, we would have expected to find the planets and asteroids scattered over the sky and also that they revolved around the sun or around each other in many and diverse ways. On the other hand, the conditions, as they are, point to a common origin and to an orderly development.

A generation ago Simon Newcomb and other leading astronomers believed that the nebular theory was "almost a necessary consequence of the only theory by which we can account for the origin and conservation of the sun's heat." As the British astronomer, Sir Robert S. Ball, explains this phenomenon: "As the sun loses heat, it contracts, and every pair of particles in the sun are nearer to each other after the contraction than they were before. The energy due to their separation is thus less in the contracted state than in the original state, and as that energy cannot be lost it must reappear in heat. . . . In this way we can reconcile the fact that the sun is certainly losing heat with the fact that the change in temperature has not been large enough to be perceived within historic times."

The second kind of evidence, that is, phases in systems outside of our solar system, which suggest stages in the development of our own, consisted chiefly in nebulæ. No telescope has been made that is powerful enough to reveal planetary systems around any of the stars, besides our sun, even if they exist. The first nebulæ to be discovered, the Great Nebula in Andromeda and the nebula in the sword of Orion, can be seen with the naked eye, and many more were discovered with the telescope. Sir William Herschel observed faint diffused nebulæ, others in which a nucleus can just be discerned, and others in which the nucleus is a brilliant starlike point. And the spiral nebulæ certainly appeared to be solar systems in the process of development. Larger telescopes resolved some of the so-called nebulæ into stars. At first this was thought to be fatal to the nebular theory, because of the natural conclusion that still larger telescopes might resolve the rest of the nebulæ into stars. But the invention of the spectroscope proved that some nebulæ were irresolvable. Thus spectrum analy-

[1]For the opinions of astronomers concerning the present conditions in our solar system, I am indebted to *Astronomy*, by Russell, Dugan and Stewart. As is obvious, our knowledge of these conditions has advanced since the nebular theory was conceived.



OUR GALACTIC SYSTEM

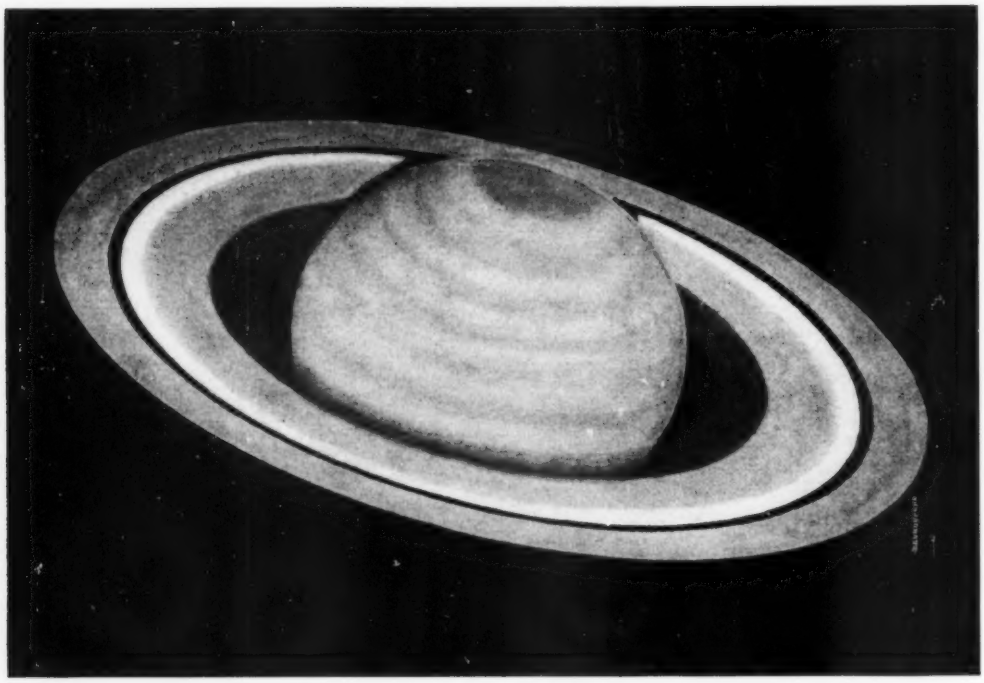
Diagram showing the island universe of which our solar system is a part. It is 200,000 light-years in diameter and 20,000 light-years thick. Our solar system is located about 50,000 light-years from the center, indicated in the drawing by the cross

AN ISLAND UNIVERSE—EDGE VIEW

Our own galactic system, if photographed edge-view from a distance of a million light-years, would probably look something like this spiral nebula (H. V. 24), in the constellation of Coma Berenices, which is between Arcturus and Leo. The dark band shown in this photograph is probably due to a ring of dark matter lying in the plane of the spiral and outside its visible extensions. Photographed March 6 and 7, 1910, exposure five hours, with the 60-inch reflector at Mount Wilson Observatory

GREAT NEBULA IN ANDROMEDA

This great spiral was the first nebula to be known, and it can be seen with the naked eye, although nearly a million light-years distant. The spectroscope proves that it is not a gaseous nebula, as formerly thought, but that it is an aggregation of millions of stars or suns. Our own galactic system is probably much like this island universe in form and in character. The spectroscope shows that the Great Nebula in Andromeda is approaching us at the rate of 200 miles a second. Photographed with 24-inch reflector, by Ritchey



SATURN AND HIS RINGS

The rings of Saturn are now known to be composed of myriads of tiny moons. Drawing by Barnard as seen through the 40-inch refractor at Yerkes Observatory, on July 7, 1898, when the rings were opened to their fullest extent

sis reëstablished the nebular theory on a firmer basis than ever.

As investigation has gone forward in recent years, the nebular theory has lost the weight of the evidence thought to be furnished by the spiral nebulæ, for these are now believed to be immense island universes outside of our own galactic system.

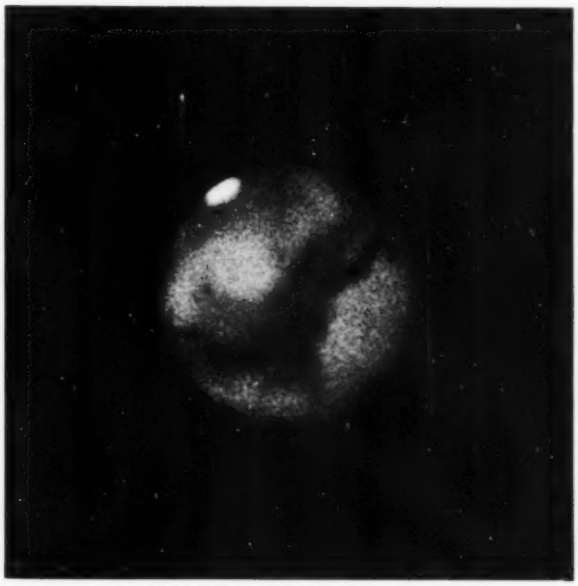
The abandonment of this splendid speculation, the nebular theory, by present-day astronomers, seems to be due to two difficulties. First, according to Russell, Dugan and Stewart, "it can be proved that an extended tenuous ring would not condense into a single body, but into many bodies, like the asteroids or the rings of Saturn. Second, almost all the angular momentum of the solar system—98 per cent of the total—is at present associated with the orbital motions of the major planets (Jupiter, Saturn, Uranus, and Neptune). The sun's rotation provides almost all of the rest, the four terrestrial planets (Mercury, Venus, Earth, and Mars) contributing less than one tenth of one per cent of the whole. The total angular momentum cannot be altered by any internal changes within the system, and no process has ever been imagined by which 98 per cent of it could have been segregated in less than $\frac{1}{100}$ of the total mass." *Angular momentum* may be defined as "the product of the mass of the moving particle into the area swept out in unit time by the line joining it to a given point."

The nebular theory attempted to explain the origin of the solar system under the action of forces entirely within the system, but this is now believed by many astronomers to be impossible. The present distribution of angular momentum is believed to be due to forces from the outside of the system.

About twenty years ago, Chamberlin and Moulton of the University of Chicago proposed an alternative theory, which would not be subject to the difficulties mentioned above. At first their theory was usually referred to as the planetesimal hypothesis, but now it certainly should be dignified by the term "theory." According to this conception, our sun in the remote past was a star without planets, and another sun or star (for all stars are suns, and our sun is a star) in its journeying through space came so close to our sun that it caused a tremendous disturbance, pulling out great masses of the sun and starting them on their revolution around the sun. By a kind of explosion, due to the disturbance of gravity, there were myriads of these masses projected into space, probably varying greatly in size,

VENUS IN CRESCENT PHASE

One can imagine the thrill that Galileo felt when, in 1610, he turned the first astronomical telescope toward Venus and found it to be a waxing and waning crescent. Since this planet shines only by reflected sunlight, it goes through phases as our moon does, and for the same reason. Photograph by Barnard through 40-inch refractor at Yerkes Observatory



THE PLANET MARS

Mars showing region of Syrtis Major. Note the cap, presumably of ice and snow, at the south pole of the planet. Photographed September 28, 1909, with the 40-inch refracting telescope at the Yerkes Observatory, by Barnard

and these were the so-called planetesimals. Not only was this new theory free from the fatal difficulties of the nebular theory, but it was found to explain the many features of the solar system, which pointed to a common origin by an orderly process, as well and in some cases better than the older theory.

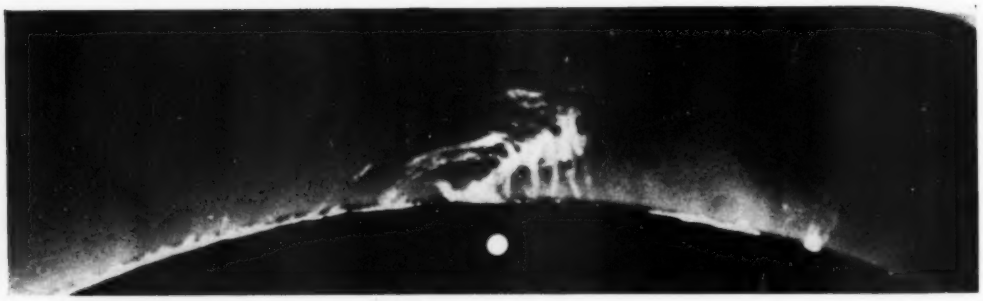
The myriads of planetesimals which were left revolving around the sun, by the action of gravity, were slowly gathered together into the planets, asteroids, and satellites. Perhaps the meteors are stray planetesimals, and perhaps the comets, which in some cases seem to be related to meteors, may also be accounted for by this theory. However, the comets have never been very

THE GREAT NEBULA IN ORION

Under favorable conditions, this amorphous, gaseous nebula, which surrounds the middle star of the sword of the Mighty Hunter (Orion), can be seen with the naked eye. It is within our own galactic system. The four-point, or cross effect, seen in a few of the larger stars in the photograph, is due to the supports of the mirror of the reflecting telescope by which the photograph was made. Photographed with 24-inch reflector, by Ritchey

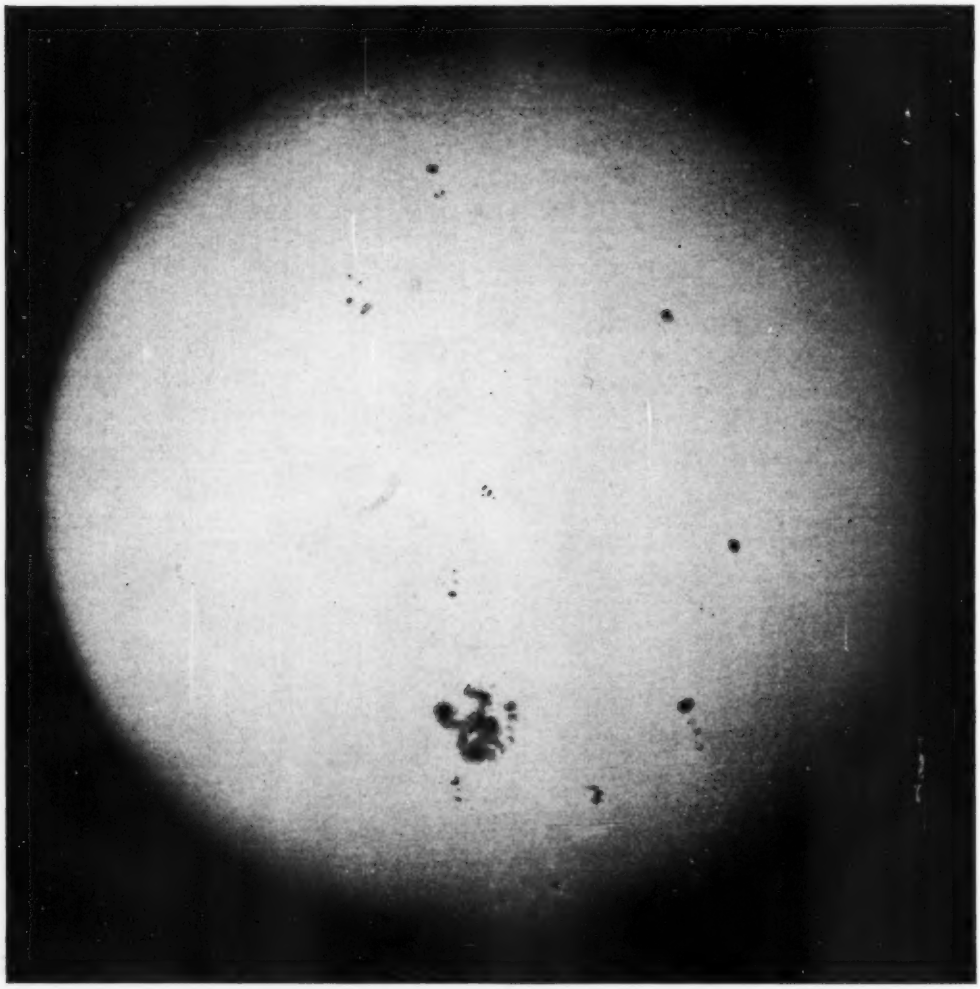
MOREHOUSE'S COMET

Morehouse's Comet swung around the sun in 1908 and was a rather conspicuous object in the sky during the autumn of that year. The telescope which held the photographic plate moved with the comet during the time exposure. Hence, the images of the stars are streaks rather than points. The tail, which always points away from the sun, seems to be made up of sheetlike streamers. Photographed with the Bruce telescope at Yerkes Observatory, by Barnard



"HELIOSAURUS" SOLAR PROMINENCE

At the total eclipse of the sun on June 8, 1918, there was a fine display of prominences thousands of miles high. The shape of this one suggested a prehistoric saurian,—hence the name. These prominences consist of hydrogen and helium. The small white spot just below the major prominence shows the relative size of the earth to this enormous eruption of flame. Photograph from the Yerkes Observatory



THE SUN AT THE PERIOD OF MAXIMUM SUN SPOTS

Sun spots are correlated with vortices in the vapor of the sun's surface, and vary in number according to a remarkable periodicity, eleven and a fraction years elapsing between one maximum and the next one. Since sun spots usually last a few weeks, one can observe the rotation of the sun on its axis by observing their position from day to day. Photographed with 12-inch refractor by Miss Calvert at Yerkes Observatory

definitely included in either the nebular theory or the planetesimal theory.

The craters on the moon, it was formerly believed, and many astronomers still believe, were of volcanic origin, but there is much in favor of the theory that they were caused by the impact of planetesimals or meteorites.

There have been modifications of the nebular theory not mentioned in this article, and there have been modifications or substitutions suggested for the planetesimal theory. Among the latter should be mentioned the tidal theory of Jeans and Jeffries, who agree with Chamberlin and Moulton in the encounter between our sun and some other star, and in most of the essential results of that encounter. According to the tidal theory, however, the planets must have possessed nearly their present masses from the time of "dynamic encounter," as Russell calls it.

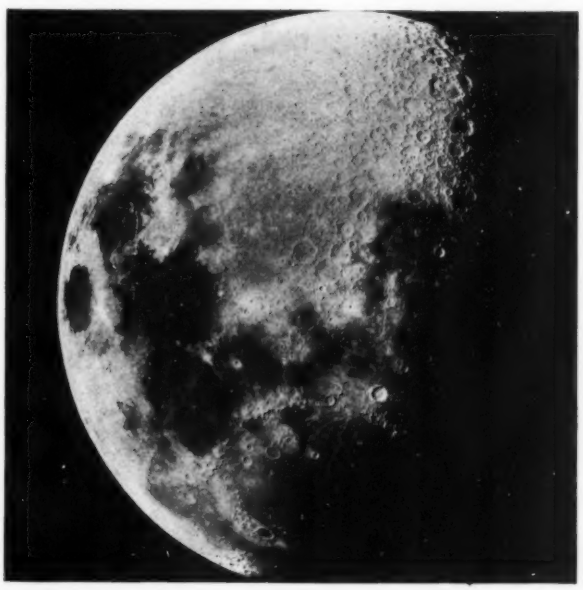
EARTH-LIT NEW MOON

"The old moon in the new moon's arms," a slender crescent embracing the earth-lit night portion of the moon. We see the "old moon," or night portion of the moon, by means of "earth-shine," or light that has been twice reflected. The light from the sun strikes the earth, is reflected to the moon, and then is reflected back to the earth. Photographed February 14, 1907, with the 10-inch Bruce telescope at the Yerkes Observatory, by Barnard

A brief, popular discussion of the planetesimal theory was given by Prof. Charles P. Berkey in his article on "Early History of the Earth," in the Astronomy Number of NATURAL HISTORY (July-August, 1926).

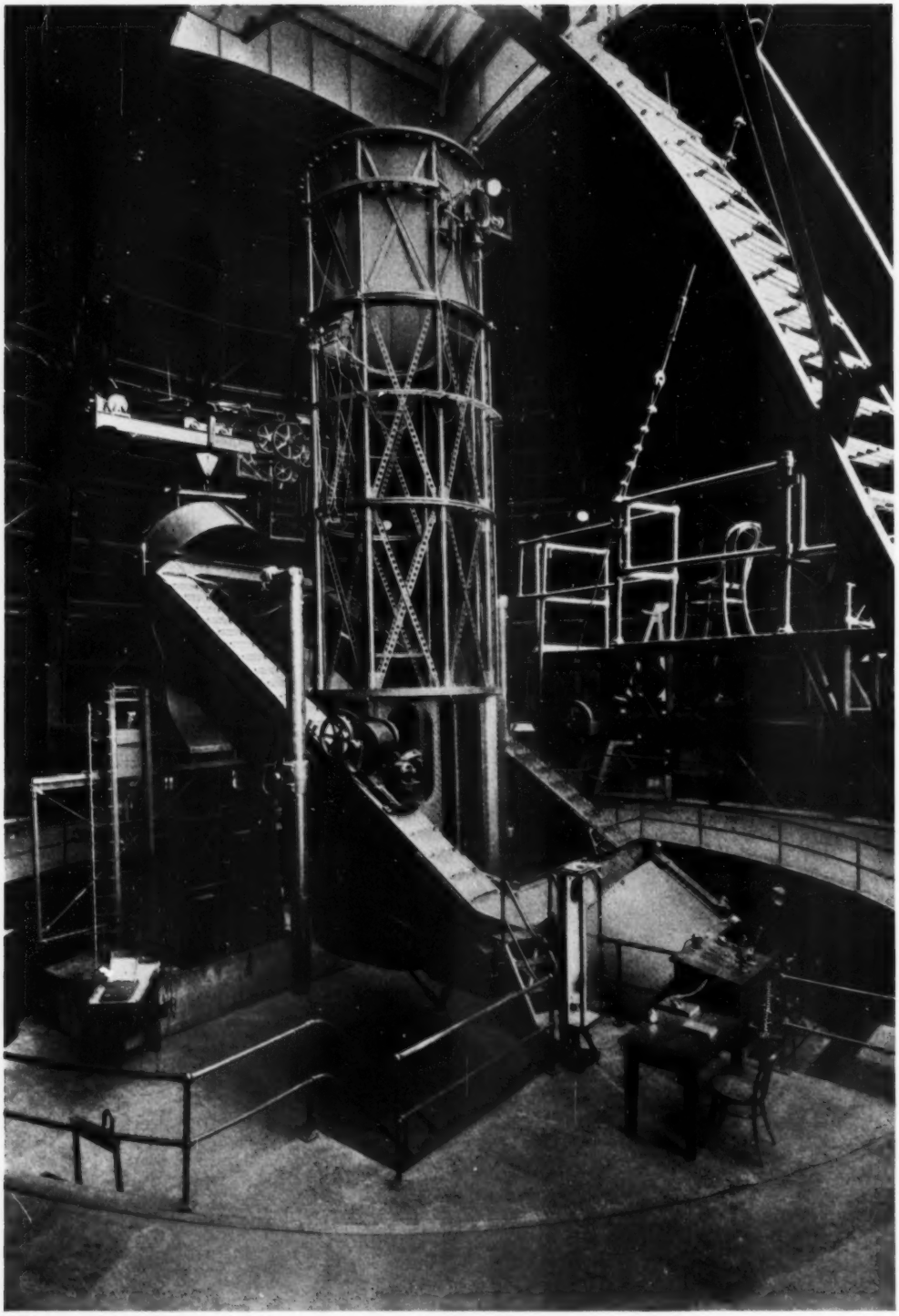
The age of our solar system, that is, the time that has passed since the great catastrophe which started its development, is estimated with a great probability to be from five to ten billions of years.

The spiral nebulæ, which it is



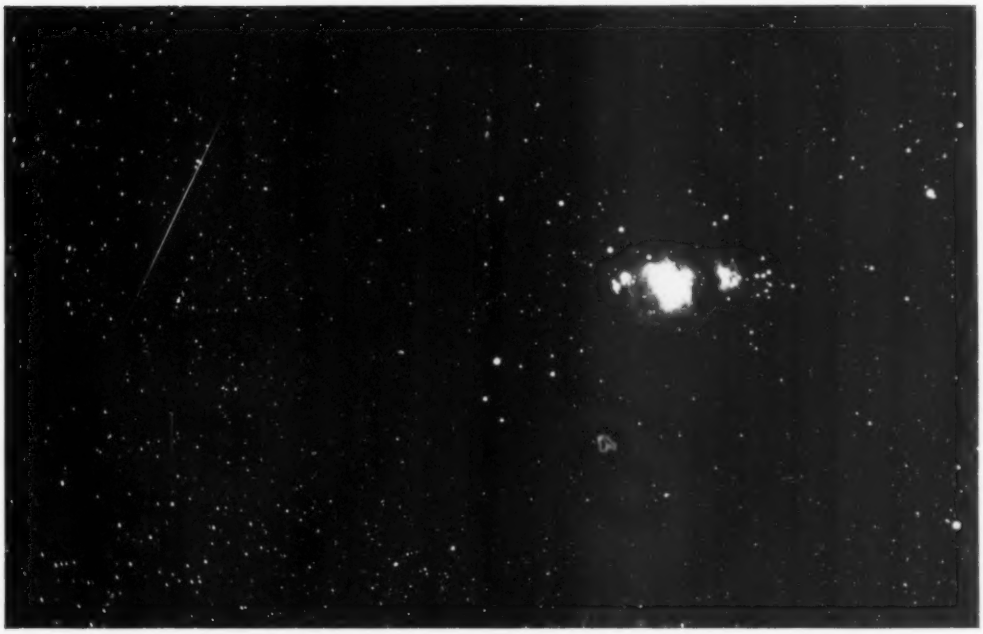
THE MOON IN GIBBOUS PHASE

The moon always turns the same side to the earth, and more than half of this side can be seen 9¾ days after new moon, as shown in this photograph. The craters show up well, as they do at first quarter and the two nights following. At this time the sun and earth are nearly at right angles in relation to the moon, and the shadows bring out the relief. Near the top (south pole) the great crater Tycho, more than eighty miles in diameter, is to be seen. Photographed with the 40-inch refractor at Yerkes Observatory



THE HOOKER TELESCOPE

This reflecting telescope at the Mount Wilson Observatory, Pasadena, California, is the largest telescope in the world, and has a huge glass mirror one hundred inches in diameter. With this instrument Hubble has been able to penetrate space to a distance of 140,000,000 light-years



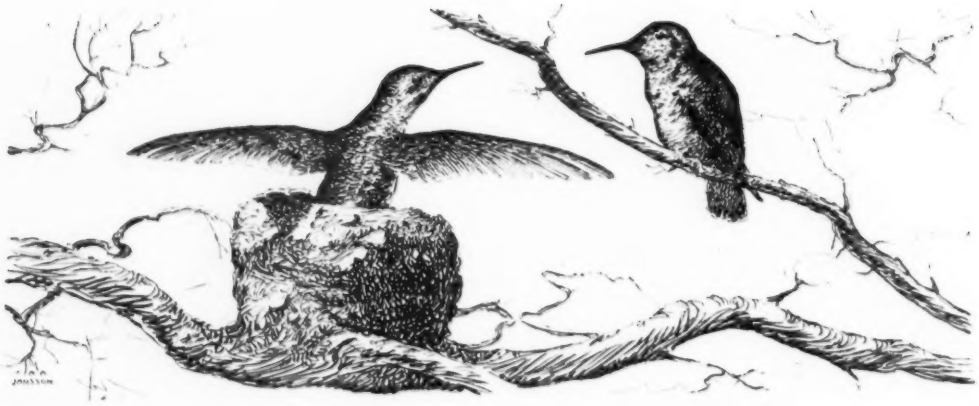
METEOR TRAIL IN THE SAME FIELD WITH THE GREAT ORION NEBULA
The bright streak on the left side of the photograph was caused by a meteor, or so-called shooting star, which happened to rush across the field while the exposure was being made. Photographed with the Bruce telescope, by Barnard

now believed are island universes, are inconceivably distant; the nearest one—the Great Nebula in Andromeda—is about one million light-years from us, a light-year being the distance that light travels in one year. When we recall that light travels 186,000 miles a second, or about 11,000,000 miles a minute, we are aided a little in our attempt to comprehend this tremendous distance. Yet many of these island universes are enormously more distant than this comparatively near neighbor.

These island universes, which were so fascinatingly treated by Dr. W. J. Luyten in the Astronomy Number of NATURAL HISTORY, are of especial interest to us, because it is believed that our sun is a part of such a universe, shaped much like the Great Nebula in Andromeda. According to Shapley, the center of our galactic universe is about 52,000 light-years from here and in the southern skies bordering on the constellations Sagittarius, Scorpio, and Ophiuchus. Our solar system is well within this watch-shaped galaxy and, when we look toward the rim, we see many stars, and call them the Milky Way. When we look toward the sides of our watch-shaped galaxy, that is, at right angles to the long diameter, we see only a fraction of as many stars, and for obvious reasons.

When we comprehend the relation of the earth to the solar system, and wonder about its origin, and when we get a glimpse of the relation of the sun to our galactic universe, and realize that there are thousands of island universes beyond the limits of ours, we naturally wonder whether they are in any way related to each other. The natural tendency of all knowledge to "unity and simplicity" makes us feel that they are.

> That very law which moulds a tear,
> And bids it trickle from its source,
> That law preserves the earth a sphere,
> And guides the planets in their course.
> —SAMUEL ROGERS.



THE HOMES OF A HUMMER

A Study in Tropical Bird Life

By FRANK M. CHAPMAN

Curator-in-Chief, Division of Zoölogy and Zoögeography, American Museum

ON January 16, 1926, I found a violet-throated humming bird (*Anthracothorax violaccicollis*) building her nest. This statement obviously requires amplification. Bird students in eastern North America, at least, are familiar only with a ruby-throated, not violet-throated hummingbird, and they are accustomed to look for humming-birds' nests in June, not in January. However, if we should follow the five-hundred-odd species of hummingbirds throughout the vast territory their family occupies from Alaska to Patagonia, and from sea-level to the summit of the loftiest Andean peaks, we should probably find one or more of them nesting every day in the year.

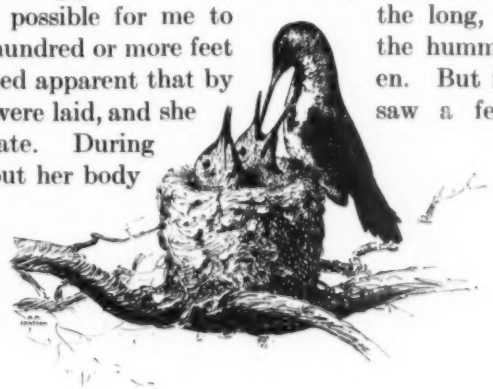
In any event, subsequent observation showed that on Barro Colorado Island in the Canal Zone, it is the habit of the violet-throated hummer to lay the foundations of her nest and her family in the first month of the year. Not only did this bird select a winter month, but she decided to place her nest in a tree already occupied by a score or more of birds many times her size. Nor did her peculiarities end here, for she chose as a site the terminal portion of a long branch projecting to windward and with not a leaf nearer than twenty-five feet. It was, in fact, the most exposed situation in the tree.

It is a very large tree, not less than one hundred and fifty feet in height and widely branched. There is, therefore, abundant room for many birds to build in it without interfering with one another. On the westerly side, where they were more protected from the strong trade winds of the dry season, a colony of oropendolas (*Zarhynchus wagleri*) were weaving their long, pendent bags on the outer branches. Nearer the heart of the tree a pair of blue tanagers (*Thraupis cana*) and of Colombian fly-catchers (*Myiozetetes texensis*) had made their homes. All were on excellent terms with one another and were doubtless quite willing to receive the humming-bird into the circle of their community life.

But the humming-bird had ideas of her own. The aggressive, pioneer spirit which has spread her kind from Magellan Strait to Bering Sea has not developed a feeling of sociability in her tiny body. She not only asked for the control of her corner of the sand-box tree but she de-

manded dominion over the entire tree, and what is more, she got it! Woe to the oropendola that ventured near her home. The fact that he was as large as a crow did not protect him. Like a winged terror she darted fearlessly at him, and evidently without thought of resistance, after dodging futilely once or twice, he would take to his wings. It was useless for him to retreat to his side of the tree. He was as helpless as a dirigible before a pursuit plane, and only the forest offered safety. Once on the warpath, the hummer attacked any bird that she chanced to meet, and not infrequently she cleared the tree before her raid was ended. Then, like a bit of down, she returned to her nest.

Fortunately for the other occupants of the tree, as the season advanced, the hummer's domestic affairs claimed an increasing share of her attention, and they were correspondingly free from attack. It was not possible for me to look into the nest a hundred or more feet from me, but it seemed apparent that by January 26 her eggs were laid, and she had begun to incubate. During this period nothing but her body stood between the eggs and destruction, one might say, from fire and water. Unshaded by leaf or branch, they might have been roasted if left exposed to the sun, and the nest-cup would have been filled to overflowing by heavy tropical showers if it had not been tightly capped by the little mother.



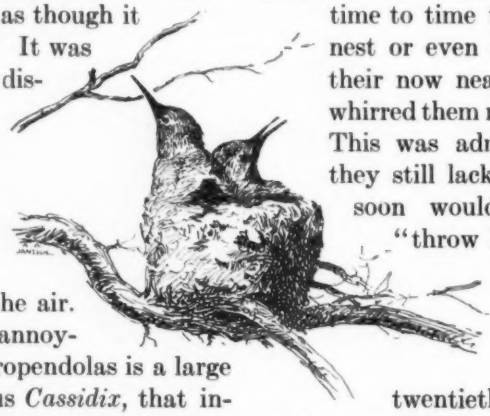
On February 9 it was evident that she had won her reward for there were young in the nest. Within a week the tips of their bills could be seen above the felted rim of the nest. With a glass one could now watch the remarkable process by which a humming-bird, after plunging her stiletto-like bill into the throat of her young, almost to the hilt, pumps predigested food well down its digestive tract.

By February 20 the entire length of the young birds' still surprisingly short bills could be seen resting on the edge of the nest, and they turned their heads from side to side with an obvious awareness of their surroundings. Doubtless they left the nest within four or five days; but here, unfortunately, my observations for the season ended. Not once during the thirty-five days of my observation did I see the father of this family. True to the habits of his kind, he had apparently deserted his bride on their honeymoon. He had, I am sure, the sympathy of the oropendolas, and at the best, there seemed to be no room for him in the family circle.

In January, 1927, when I returned to Barro Colorado to continue my studies of the oropendolas, I saw with regret that the long, bare limb, on which the hummers nested, had fallen. But from time to time I saw a female violet-throated humming-bird pursuing the oropendolas, and I concluded that somewhere in the great tree she had a home. The tree was now fully foliaged, and to find a humming-bird's nest within its innumerable branches seemed beyond the bounds of possibility. Nevertheless, with the aid of a 24-power binocular, mounted on a tripod, I determined to examine it systematically. The search began on January 19 and it ended the minute it began, for the first sweep of the glass revealed the bird seated on her nest. She had selected the nearest branch to the one that had fallen. Whether I was looking at my friend of the preceding

year I shall never certainly know. But the fact remains that the same species was nesting in nearly the same place and at nearly the same time. Furthermore, the oropendolas will testify that she acted in nearly the same way!

My notes show that she was attending to her duties day after day, with an occasional foray into oropendolum by way of relaxation, until January 29, when the record reads: "The hummer's nest has disappeared. I cannot find the slightest trace of it or of the bird herself." I could not explain her disappearance, but whatever may have been its cause, it did not prevent her or one of her kin or kind from returning to the sand-box tree in 1928, and building a nest on (as nearly as I could tell) the same limb occupied in 1927. For the third successive year, therefore, a violet-throated humming-bird nested in essentially the same place at practically the same time. It looked very much as though it were the same bird! It was January 11 when I discovered the female building, and this year nothing prevented me from following the growth of her family until its members took to the air.

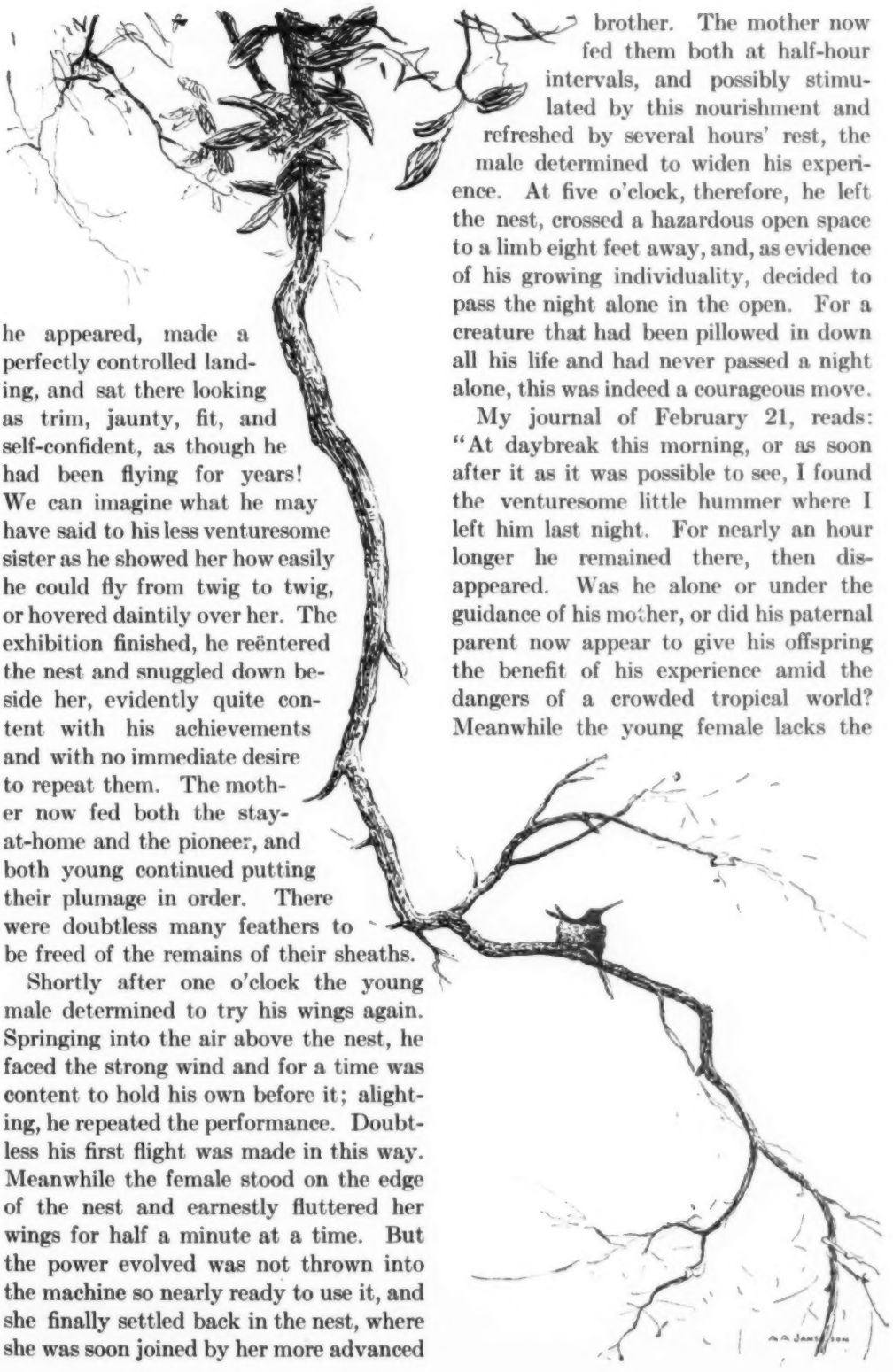


One of the most annoying enemies of the oropendolas is a large cowbird of the genus *Cassidix*, that insists on depositing her eggs in their nests. She is wholly without shame and, when her wants are pressing, only the combined forces of the oropendolas prevent her from gaining access to their homes. It was in such an emergency that the violet-throated hummer first showed a feeling of responsibility as a member of the sand-box tree community. Although both she and her nest were beneath the notice of *Cassidix*, she attacked the blackbird with marked virulence, often driving her not only from the vicinity of her home but continuing the pursuit until the would-be parasite was forced to leave the tree.

January 12 the hummer added the last touches to her nest, and two or three days later, without loss of time, she concentrated her boundless energies on the task of incubation. I have no record of the day her twins appeared, but on February 3 the tops of their heads were first seen above the edge of the nest. A week later their bodies filled the nest and they were so well feathered that, after feeding them at sunset, their mother left them for the night.

By February 16 the nest was not only filled but overflowing with young hummers. They were alert and observing, and passed much time in preening their plumage, as though they were oiling their engines before taking flight. In further preparation for this great event, from time to time they stood up in the nest or even on its rim, stretched their now nearly grown wings and whirred them rapidly in a mazy blur. This was admirable exercise, but they still lacked the impulse which soon would prompt them to "throw in the clutch." The power was there, but not the courage to use it. Early on the morning of the twentieth the twins were still in the nest. The wind was high and they were tossed about as though in a stormy sea, but in the calm intervals they resumed the alar exercises that would make them master mariners in any weather. They looked as though they might "hop off" at the word "Go" and, when an hour later I returned from the forest, only one remained. While I was debating whether the missing bird had been blown off the nest during his[1] exercises, behold,

[1]The characteristics of this bird seem to warrant the use of the masculine pronoun.



he appeared, made a perfectly controlled landing, and sat there looking as trim, jaunty, fit, and self-confident, as though he had been flying for years! We can imagine what he may have said to his less venturesome sister as he showed her how easily he could fly from twig to twig, or hovered daintily over her. The exhibition finished, he reëntered the nest and snuggled down beside her, evidently quite content with his achievements and with no immediate desire to repeat them. The mother now fed both the stay-at-home and the pioneer, and both young continued putting their plumage in order. There were doubtless many feathers to be freed of the remains of their sheaths.

Shortly after one o'clock the young male determined to try his wings again. Springing into the air above the nest, he faced the strong wind and for a time was content to hold his own before it; alighting, he repeated the performance. Doubtless his first flight was made in this way. Meanwhile the female stood on the edge of the nest and earnestly fluttered her wings for half a minute at a time. But the power evolved was not thrown into the machine so nearly ready to use it, and she finally settled back in the nest, where she was soon joined by her more advanced brother. The mother now fed them both at half-hour intervals, and possibly stimulated by this nourishment and refreshed by several hours' rest, the male determined to widen his experience. At five o'clock, therefore, he left the nest, crossed a hazardous open space to a limb eight feet away, and, as evidence of his growing individuality, decided to pass the night alone in the open. For a creature that had been pillowed in down all his life and had never passed a night alone, this was indeed a courageous move.

My journal of February 21, reads: "At daybreak this morning, or as soon after it as it was possible to see, I found the venturesome little hummer where I left him last night. For nearly an hour longer he remained there, then disappeared. Was he alone or under the guidance of his mother, or did his paternal parent now appear to give his offspring the benefit of his experience amid the dangers of a crowded tropical world? Meanwhile the young female lacks the

initiative to leave the nest and without the incentive of her twin's example her launching will doubtless be still further delayed."

Two hours after this was written the young adventurer came home. For a quarter of an hour he did his best to induce his sister to enter the world with him. First he used suasion, standing on the edge of the nest and "racing" his wings. This having no effect, he employed force, poking his sister's neck and body with his bill, pulling her wing and sparring with her. But his efforts being of no avail, he settled down in the nest and crowded her to the opposite side.

It might be imagined that the male's action was designed to make a place for himself in the nest, but no similar passage had been seen between the two young birds before, and during part of the time that he was so energetically prodding his sister, she was perched on the opposite wall of the nest, leaving its center free for his occupancy had he desired to use it.

After an hour's rest and two good meals from his mother, the young male set out in search of further adventure, and his sister, after being crowded for days, stretched herself out to enjoy the whole nest. But in the evening she was called upon to share it again. At 5:30 her wandering brother returned, claimed his share of the now much worn nest, and after they had been fed by the ever attentive mother, they settled down for the night.

They had not arisen at sunrise the following morning, but an hour later the male left his bed for a near-by branch, where he could more easily make his toilet. This completed, with much nervous twitching of the tail, betraying the forces within, he arose and fluttered over his ultra-cautious sister. Then like a dart he was off to the forest, perfect master of the delicate mechanism which makes a hummer's flight, with its abrupt turns, its sudden stops, its aërial dancing, a marvel of dashing but controlled movement.

Meanwhile the weak sister bided her time; when her brother perched at her side, she stood on the rim of the nest and made a brave effort at flight; but it was all a gesture, and when he had gone, and with him the inspiration, she sank comfortably back in the nest. But she could not deny the call to wings much longer. When next she "raced her engines" something happened, and suddenly she found herself perched on a twig above the nest. It was not a very long flight, only about six inches, but it was a flight and it was both convincing and encouraging.

After a rest of fifteen minutes and a general survey of her new surroundings, she ventured ten inches farther to windward and perched again. It was a short flight, but it had the important elements of starting and stopping; both were made with the skill of a veteran and, evidently flushed by success, the little aviator sat there looking very sprightly and quite self-satisfied with her achievement, even if she was three days behind her brother. With unaccustomed freedom she now gave her plumage a thorough overhauling from the foothold of a firm if widely swinging branch. But this important operation was abruptly interrupted.

With complete disregard of the law of trespass, a male trogon alit above the nest and began to sound its mournful note, wholly ignoring the heir to this territory who, from her perch not three feet away, regarded the intruder with unconcealed surprise. Preening was suspended, and the tiny bird, with bill inquiringly pointed at the stranger, was all attention. She was meeting her first bird outside the members of her own family and at the same time learning that if you want your rights in this world you must get them for yourself. But what could a midget hummer, with only sixteen inches of flying experience, do to expel a bird thirty times or more her

size? Nothing; she could only sit and wonder with that sharp little bill pointed upward at the huge creature. But she was far from being without a champion. From the air a small dark object hurled itself at the trogon and with equal speed swung back again. Vainly the large bird swayed and ducked; at the fifth attack he seemed to be fairly knocked from his perch. It was evidently a glancing blow, for the fury of the fiery little creature carried her past the trogon toward the baby hummer who, swept from her perch, either by a direct hit or the brush of her mother's wings, disappeared below. In a moment the mother returned, perched on the edge of the nest and, for the first time since the eggs were laid, found it empty. She remained for only two or three seconds and was off, perhaps to search for the victim of her own maternal aggressiveness.

It seemed impossible, however, that the delicate little creature could have survived. Even if she had not been struck by her impetuous mother, she was far from prepared to save herself from the innumerable dangers of the world into which she had so suddenly been forced.

But I evidently underrated both the physical and mental powers of young hummers. That evening both brother and sister returned. One, probably brother, sought a perch some thirty feet from the nest, the other came to within three feet of her birthplace. The faithful, and doubtless greatly relieved mother flew from one to the other, feeding each in turn and copiously.

At sunrise the next morning they had gone; nor did I see them again. But the end was not yet. On March 12, that is, just sixteen days later, the mother returned to the nest and started a second family! Meanwhile, unobserved, she had renovated the old home and added new material to its walls. What an exhibition of exhaustless, irrepressible vitality!

On March 24 she was still sitting. Here my observations for the season came to an end, but if, as I believe, twins appeared within a day or two, it is obvious that their mother is not so completely separated from her mate as his apparent absence during the preceding sixty-seven days would lead one to believe.

"ROBINSON CRUSOE'S CHILDREN"

The Strange Story of Nine English Mutineers Who, More Than a Hundred Years Ago, Took Up Their Abode With Their Native Tahitian Wives, on a Desert Island in the South Seas.—The Life and Heredity of the Descendants of These First Settlers on Pitcairn and Norfolk Islands

By H. L. SHAPIRO
Assistant Curator of Physical Anthropology, American Museum

ON two remote South Sea Islands, Pitcairn and Norfolk, dwell the descendants of the notorious mutineers of the "Bounty." With only intermittent contact with the outside world, this two-fold colony has maintained its integrity for almost 140 years. The physical anthropologist could not ask for a more interesting group with which to work.

The history of the Norfolk and Pitcairn Islanders goes back to the Eighteenth Century when Bligh, in command of the "Bounty," sailed from England on a botanical voyage to the South Seas. His mission was the result of petitions from the West Indian planters to the British Government that the widely heralded breadfruit of Polynesia be transplanted to the West Indies, where it might serve as an easy source of food for the plantation slaves. In October, 1788, ten months after leaving England, the "Bounty" reached Tahiti.

Even in these days of short and comparatively luxurious voyages, it is easy to imagine the great delight of the sailors on landing at one of the pleasantest of the South Sea Islands, where both Nature and the natives were kind. Bligh, in his journal published some years later, speaks of the rapidity with which each sailor soon had his particular "tyo" or friend, who acted as host during their stay at Tahiti.

After six months spent in collecting breadfruit and other indigenous plants, Bligh set sail from Tahiti in April, 1789. The partings were long and melancholy, and it was with evident reluctance that the crew set their sails to the breeze which was to carry them away from the scene of six happy months. Added to the discontent engendered by these farewells, was the familiar harshness of Bligh. One of the sufferers from Bligh's behavior was Fletcher Christian, the mate, who on several occasions had felt the lash of his captain's tongue. We can never know the true cause of the mutiny, but we may guess that the resentment of Christian found a ready response in the crew, discontented with their master and at leaving Tahiti.

Early on the morning of the 28th of April, the "Bounty" was in the neighborhood of the Tongan or Friendly Islands, when Captain Bligh was forcibly awakened by several armed men and discovered that he was a prisoner on his own ship. In his journal he recorded that he was entirely unaware of any mutinous feelings among the sailors, and from other evidence it seems that the mutiny was spontaneous. All Bligh's efforts at persuading the men to give up their design were unavailing. At each attempt he was ordered to hold his tongue or he would be a dead man. Eighteen of the crew who were not in the plot were also taken prisoners, and the Captain and his faithful men were put adrift in a small boat weighted down almost to the gunwales. Only scanty provisions, consisting of 150 pounds of bread, 32 pounds of pork, 6 quarts of rum, 6 bottles of wine, and 28 gallons of water, were furnished.

Whatever our estimate of Bligh's personal character may be, we must grant him the great qualities which he exhibited in this difficult situation. In a crowded, under-provisioned boat, he determined on the bold plan of sailing for Batavia in the East Indies, where he could expect to find a haven and assistance. His voyage of 3000 miles, completed in forty-six days, over uncharted and dangerous waters, has remained to the present day a classic in navigation. There were other hardships which almost defeated Bligh. Hunger, raging thirst under the tropical sun, and attacks from hostile natives soon weakened the resistance of the men who looked to Bligh for guidance. He did not fail them, although he was forced to use drastic methods to save the men from themselves.

Christian, at the head of the twenty-five mutineers, now returned to Tahiti, where they accounted for Bligh's absence with the story that he had met with Captain Cook, and that the "Bounty" had been sent back for more supplies. After several unsuccessful attempts at establishing a colony on a near-by island, Christian and the mutineers returned to Tahiti, where they separated into two parties. Sixteen of the men preferred to remain at Tahiti where they very soon set up menages. The other nine, anxious to find an inaccessible island where they might be safe from a punitive expedition from England, left Tahiti, taking with them about twelve native women and six native men.

When Captain Edwards of the "Pandora," sent to capture the mutineers, reached Tahiti a couple of years later, nothing was known of the fate of Christian and his men.

Not until 1808 was a trace of the missing men discovered. In that year Captain Mayhew Folger of Boston was

Photograph by Rollo H. Beck

PITCAIRN DWELLING

In the early days the planks were laid vertically, unlike those in this picture. Considering the isolation of the island, it is interesting to note the use of corrugated iron. Thatching with pandanus leaves was derived from Tahiti

very much surprised to find himself hailed in English by the children of the mutineers when he touched at Pitcairn, which he believed to be uninhabited. He learned from the sole surviving male, John Adams (formerly Alexander Smith), that on reaching Pitcairn in 1790 the "Bounty" was destroyed so that there might be no defection. Each of the nine sailors received an equal allotment of land.

Owing to the treatment which the native men received at the hands of their white companions, they soon rebelled. Dissension among the sailors on account of the women and fighting with the native men led to a series of horrible and brutal crimes, which ended in the murder of all the native men and all but four of the sailors. Of these, M'Coy, who in his youth had worked in a Scotch distillery, discovered the intoxicating qualities of a distillation of the ti plant. It was reported that he jumped over a cliff in a drunken frenzy.

Quintal was murdered by Young and Adams in self-protection. The only natural death was that of Young, who died in 1800, leaving Adams alone with the women and the children of the various unions of the sailors with the native women. Later visitors described Adams as a patriarchal figure, fathering the whole little colony, imparting his small store of learning and religion, and prescribing the line of conduct to be followed by his charges.

So unexpected and dramatic was the idyllic life of the Pitcairn Islanders after the violence which attended its establishment, that this remote island and its inhabitants served many a preacher for a text on the beauties of a Christian life. Rare copies still exist of a small pam-

THE "RESOLUTION" AT NORFOLK
This boat, recently completed in the expectation of a lucrative fruit trade with New Zealand, is the most ambitious ever built on Norfolk

Photograph by Rollo H. Beck

CHURCH ON PITCAIRN

This is the largest structure on Pitcairn and was built about seventy-five years ago. It is now used as a church and community meeting house, as well as a schoolhouse

phlet distributed among American Sunday Schools early in the Nineteenth Century which related the story of the Pitcairn Islanders for the edification of young readers.

Except for the rare arrival of a ship, the calm of Pitcairn was unbroken. In 1831 the islanders made an attempt to establish themselves on Tahiti, where they might have more room for expansion. This ended in disillusionment and a return to Pitcairn. Nothing more was done about the dread of overpopulation, which motivated the move to Tahiti, until 1855, when they petitioned the British Government to remove them to Norfolk, which was being abandoned as a penal island. Consequently in 1856 the whole community was transferred to its new home on Norfolk, where for the first time they saw stone buildings. Although Norfolk is considerably larger than Pitcairn, and its beauty attracted many of the islanders, some of the colony were homesick for Pitcairn. After a few years several families returned to Pitcairn, where their descendants still live. But the principal group still dwells contentedly on Norfolk. Some years afterward, against the wishes of the islanders, the Melanesian Mission established a station on Norfolk, but recently it was abandoned.

Life on Pitcairn was largely dependent on the fruits and crops of the island. In later years chickens and cattle were added to the resources of the colony. From the nature of its beginnings the colony was, in a sense, a sociological experiment. The sailors found themselves in a *milieu* which was utterly different from their own environment, and they were forced to make use only of the materials which they could secure on the island.

The only men of education and learning died or were soon murdered. John Adams

Photograph by Rollo H. Beck

MEETING THE SHIP

The Pitcairn Islanders are excellent boatmen. They are shown here following their usual custom, coming out to meet a newly arrived ship

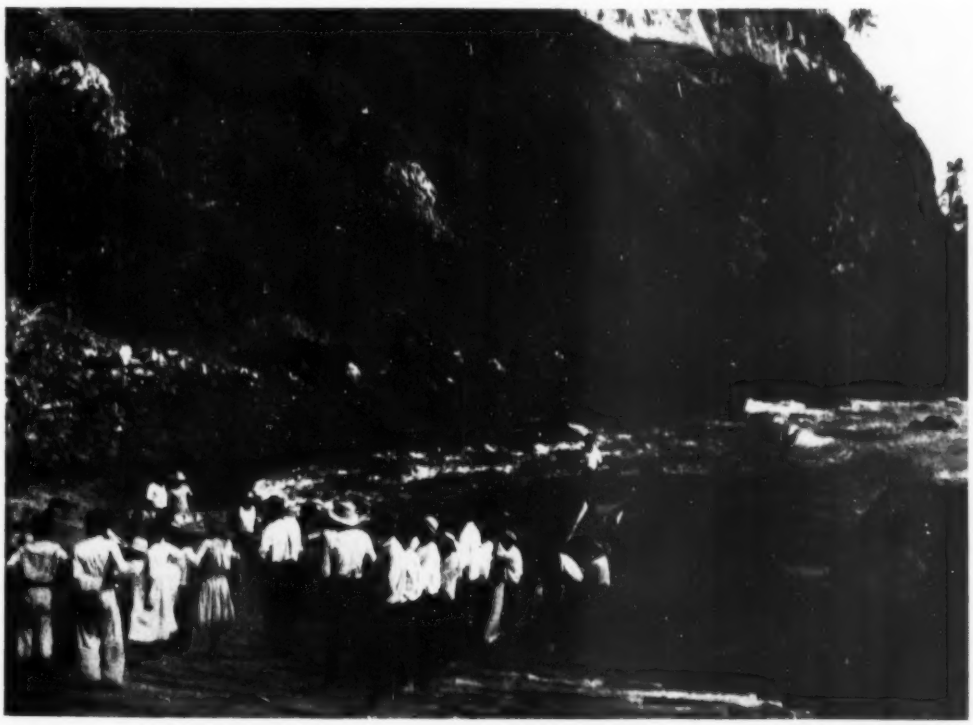
A WHALE ON THE SHINGLE

Whaling is still an important industry on Norfolk from July to October. Great strips of blubber are hauled up on the shore by a team of horses to vats where the oil is extracted

Photograph by Rollo H. Beck

THE FIRST HOME OF THE MUTINEERS

Pitcairn is a small, precipitous, volcanic island, first discovered by Carteret. It is covered with luxuriant tropical foliage



Photograph by Rollo H. Beck

HISTORIC LANDING PLACE AT PITCAIRN

Landing at Pitcairn is extremely dangerous, but the islanders are skillful in maneuvering the boats so that, riding on the crest of a wave, they are able to make a safe landing

DEDICATION OF A NEW CHURCH
The church was built by the Norfolk Islanders through the inspiration and devotion of "Uncle" Cornish (the bearded man)

was almost illiterate, tracing the meanings of words with great difficulty, and he had no knowledge of government or law. Consequently it is remarkable to trace the development of a workable code of self-government and conventions. Almost from the beginning the women had an equal share with the men in the election of the officials who took over the guidance of the colony after Adams' death in 1829. Property was inherited alike by all the children regardless of sex. Education was compulsory up to the age of sixteen. This consisted in learning to read, write, and cipher, with a greal deal of Biblical history. For a time there was a communal fund of food to which all contributed. Later, when trading assumed greater proportions, definite regulations were adopted to govern the methods and standards of exchange.

The houses were built in an original fashion. The planks were placed vertically in grooves cut into large timbers which made the frame of the house. Some were two stories in height and were grouped about a central commons. The clothing was made by the women from tapa manufactured according to Tahitian methods, although later they were able to secure clothes from whalers and others who visited them. The manner of cooking was very reminiscent of Tahitian cooking. A whole pig would be baked in a pit dug in the ground and covered over with a mat of leaves.

One of their most interesting contacts was with the New England whalers who swarmed in the Pacific in the middle of the last century. Many of the young men shipped on long cruises, returning with Yankee tricks of speech and customs. Frequently the captain would leave his wife at Pitcairn to be picked up on the return voyage. During such visits these efficient New England housewives in-

troduced many innovations, so that even at the present time pie is a favorite dish. During my stay at Norfolk I was the guest at a Thanksgiving dinner at which all the traditional dishes were served.

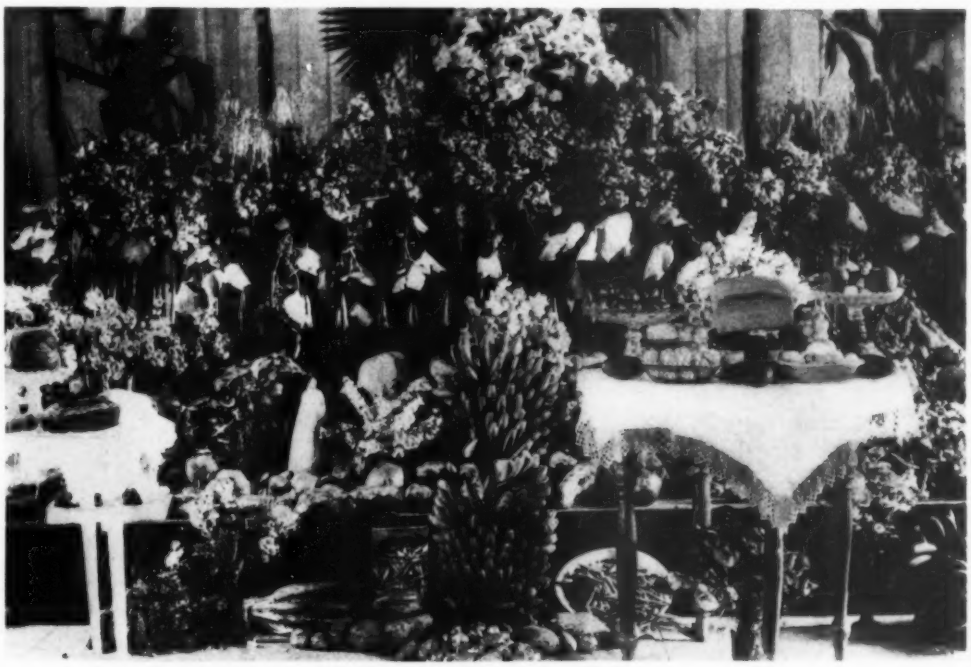
One of the most valuable things inherited from the whalers is the technique of whaling. On Norfolk, whaling is still practiced and is a lucrative source of income.

Since the necessities of life on Norfolk and Pitcairn are few, the principal occupation is raising sufficient food to supplement the wild fruits that grow abundantly. An additional source of income on Norfolk is the preparation of lemon juice, which is shipped to Sydney, Australia.

For entertainment the Norfolk Islanders are dependent on European games and amusements. Tennis is a favorite form of sport, and a tournament is held annually for a shield. Cricket, football, and horse racing are also popular. More sedentary games such as checkers, cards, and chess, find enthusiastic devotees. During my visit a weekly dance was held, which attracted all the younger people. Also once a week a moving picture show was given. The social life of the islanders is very hearty and informal. Moonlight picnics, garden parties, and other gatherings of a social nature are always hilarious. A strong love of music is common, and one of the most generally attended organizations is the choral society.

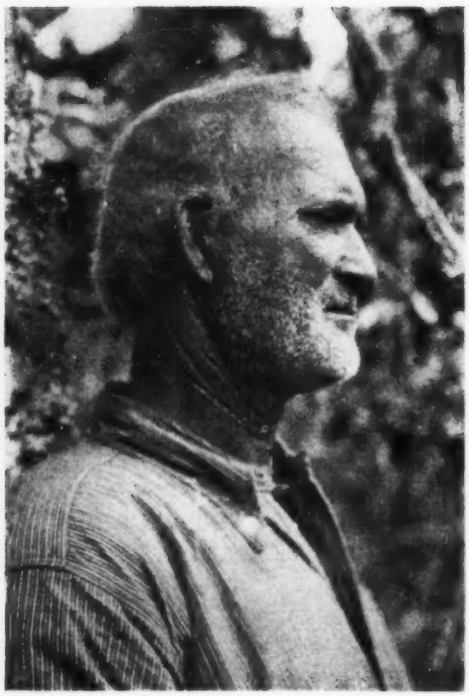
The Australian Government maintains a doctor on the island, and the school, which is free, is attended by all the children. An administrator represents the Australian Government, but the islanders are allowed to manage their local affairs through a body of elected officials. Taxes are paid in the form of public work, which consists in building roads and repairing public buildings.

Most of the islanders are affiliated with



THANKSGIVING ON NORFOLK ISLAND

This holiday is celebrated on Norfolk with a feast and church service. Flowers, fruits of the field, and domestic products are exhibited and used as decorations in the church



NORFOLK TYPES

These individuals belong to the fourth and fifth generations from the original English-Tahitian cross. English as well as Tahitian characters reappear in these types

NORFOLK TYPES

Note the strong Northern European appearance of the girl at the lower left. The woman at the lower right represents the Tahitian type

LUNCHING AL FRESCO

Picnics are popular on Norfolk. "Uncle" Cornish, the benevolent guide of the author of this article, is shown here. He is a grandson of Matthew Quintal, a mutineer

the Church of England, but other denominations such as Methodist, Seventh Day Adventist, and Baptist have adherents. Pitcairn, however, is now almost entirely Seventh Day Adventist. The principal church on Norfolk is a large Georgian building of gray stone which is a relic of the penal colony. On alternate Sundays the congregation meets at the former chapel of the Melanesian Mission station, which is beautifully decorated with mother-of-pearl, inlaid in Melanesian designs, and has a number of beautiful stained glass windows designed by Burne-Jones.

The present population is approximately 600 on Norfolk and more than 175 on Pitcairn. Many of the younger members of the community have in recent years sought wider opportunities on the mainland, where they have married and settled, so that the total number of living descendants of the mutineers is probably more than a thousand.

To the anthropologist, the chief interest of the descendants of the mutineers of the "Bounty" lies in the fact that here is an example of race mixture between two contrasted races. In studying race mixture it is always discouraging when one attempts to define the ancestry precisely. Where the mixture has been long continued, it is frequently hopeless to obtain satisfactory genealogies. The Norfolk Islanders, however, have kept records of marriages and births, so that I have been able to make for all the islanders genealogical tables which go back to the original cross, and in that way determine the proportions of Tahitian and English in the population. There is somewhat more English "blood" in the present generation. In studying the qualitative characters such as eye color, skin color, and hair form and color, one finds among these hybrids evidence of genetic behavior along Mendelian lines. The typical phenomena of dominance and segregation have taken place. In a small proportion the recessive traits such as blue eyes, blond hair, and fair complexion, are combined in one individual. An example

of this type is shown on page 299. On the other hand, one finds, according to expectation, a number of individuals who are strikingly Tahitian in appearance. On the whole, Tahitian and English characters form a mosaic, the totality of which in some tends toward the English and, in others toward the Tahitian. Heterosis or hybrid vigor, which is frequently observed in the first generation after the original cross, is well illustrated in the stature of the Norfolk Islanders. Early records indicate that the hybrids in the first generation were considerably taller than either Tahitian or English. Although this excessive stature has diminished among the Norfolk Islanders, it is still greater than that of the parent stocks.

From necessity the islanders have inbred from the beginning, so that now after five or six generations, everyone is related to the rest of the community. In some cases the degree of blood relationship between husband and wife is extremely close. Yet there are no evidences of deterioration. On the contrary, the Norfolk Islanders are tall, muscular, and healthy. That inbreeding mysteriously produces degeneracy is now disproven by animal experimentation. Among the Norfolk Islanders we have another example that inbreeding in a sound stock is not attended by the traditional stigmata of degeneration.

Vital statistics reveal some interesting physiological facts in the hybrids. In the second generation the average number of children per family was 9.1. This average is greater than in any other generation. In the same generation the average age at marriage was 16.8 years for the women and 20.9 for the men. In later generations these ages increased. This high point in fertility exceeds the fecundity even of the Rehobother Bastards studied by Fischer.

Although there have been several additions of Europeans to the Norfolk community, their influence has been relatively slight. One can only hope that this fascinating group may be allowed to maintain its identity and continuity.

Photograph by Rollo H. Beck

A BOATLOAD OF PITCAIRN ISLANDERS

These men are sturdy members of the subsidiary colony now living on Pitcairn, where they number more than 175

Mayon, a volcano of the Philippines, 7916 feet high and 120 miles in circumference, rises from a plain to form a perfect cone. For centuries its vapors gave forth a fiery glow at night, but now all is quiet. There were 26 eruptions in the Nineteenth Century, those of 1814 and 1897 being of great violence. The last important outbreak occured in 1900. In all probability the next eruption will be exceptionally violent

VOLCANOES IN ACTION

By CHESTER A. REEDS

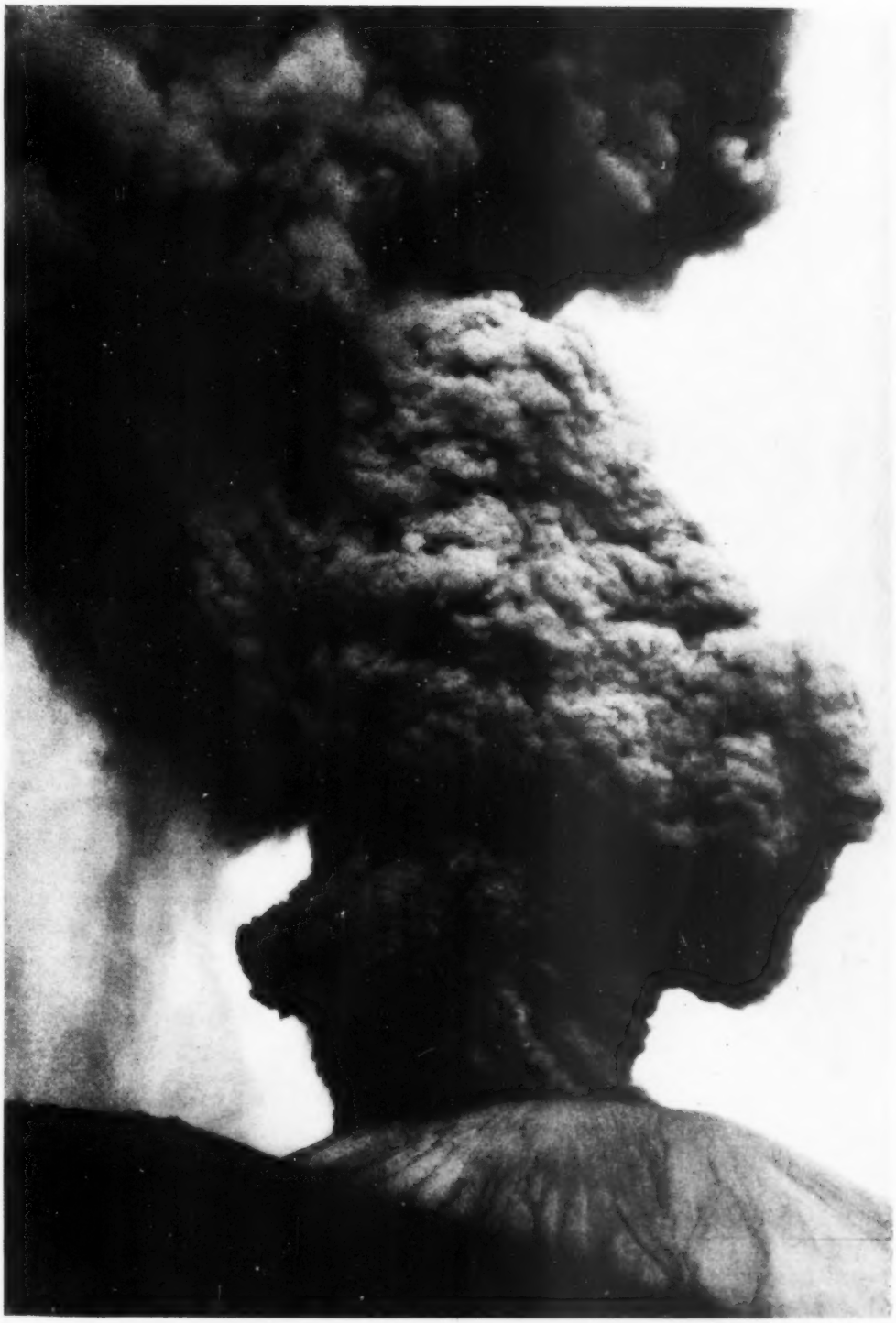
Curator of Geology and Invertebrate Palæontology, American Museum

With Eleven Photographs and Captions by Dr. F. A. Perret, Volcanologist

THE eruption of a volcano is perhaps the most impressive and awe-inspiring phenomenon known. The stupendous releasing of matter and energy, the unhurried modulation of its periodic beats, the seismic pulsing of the ground, and the exceedingly rapid undulations of electric flashes in the cloud of ash, produce not only a sublime manifestation of rhythm, but of infinite dignity. Perret, in 1924, writes: "No words can describe the majesty of its unfolding, the utter absence of anything resembling effort and the all sufficient power to perform the allotted task and do it majestically." The immensity of these forces, the magnitude of the results achieved, and the disastrous consequences, which an eruption frequently entails, impress the human mind with the vast amount of dynamic energy pent up within the earth.

The sixty-six active volcanoes scattered over the surface of the earth are not in maximum eruption every day. Judging from their known histories, it is apparent that each volcano acts more or less independently of the others, and that the activity of most of them is intermittent with paroxysms of greater or lesser violence occurring after intervals of comparative, or even complete, repose. Stromboli, one of the Lipari Island volcanoes, has been characterized by a moderate, though somewhat constant activity during two thousand years. To mariners it is known as the "lighthouse" of the Mediterranean. If the period of quiescence has been long, the renewed activity of a volcano is apt to be exceptionally violent. For instance, Krakatoa, near Java, had been dormant for about two centuries before the great eruption of 1883. It is reported that Bandaisan, the Japanese volcano, was silent for more than one thousand years before the tremendous outburst in 1888.

One of the greatest of volcanic eruptions in recent years was that of Sakurajima in southern Japan. This volcano, with a cone shaped very much like Vesuvius, rises to a height of 3506 feet. Previous eruptions of this volcano had built up a circular island about seven miles in diameter in Kagoshima Bay, and upon it there were eighteen villages with an aggregate population of 22,000 farmers and



Photograph by F. A. Perret

THE CRATER CLOUD OF VESUVIUS, APRIL, 14, 1906

Interior avalanches of crater material caused great clouds of gas and ash—half a mile in diameter—to rise in majestic spiral curves during the closing days of the 1906 eruption

Photograph by F. A. Perret

AN EARLY PHASE OF THE GREAT ERUPTION OF VESUVIUS, 1906

The emission of gas and ash from the pulsating volcano was like the puffing of a gigantic locomotive on a heavy grade. The white vapors are from lava that issued from near the base of the cone

fisher folk. Two miles of water lay between the western margin of the volcanic island and the shore of the larger Kyushu island on which stood the city of Kagoshima with a population of 70,000.

The observatory of Kagoshima had recorded 91 earthquakes in 1913 as compared with only 34 for each of the years preceding. Early in January this station noted an ever increasing number of earthquakes, and between 4 A.M. of January 11, and 10 A.M. of January 12, 417 quakes were recorded, many of them strong. The situation was ominous, and due to a knowledge of the significance of earthquakes in the vicinity of volcanoes, developed in Japan since 1890, the people in this region were forewarned, and those who dwelt on Sakurajima Island were removed prior to the violent eruption, which began at 10:05 A.M. of January 12, 1914.

The first outburst of gas, steam, and ash, which was from the western vent opposite the city of Kagoshima, reached elevations between five and six miles in height. Ten minutes later a similar column rose from three crater pits on the eastern side of the mountain. Glowing bombs, hot sand, flashes of lightning, great billows of smoke, and seismic shocks waxed in fury. A terrific earthquake at 6:29 P.M. threw down walls and buildings in Kagoshima, causing the death of 35 persons, and the injury of 112, the only casualties during this great eruption. This great shock was accompanied with the outflow of lava on both the eastern and western sides of the volcano. Following these great outbursts, intense activity continued in the western craters until January 20, while in the eastern ones it persisted for several months.

Prof. T. A. Jaggar, of the Hawaiian Volcano Observatory, who has written an interesting account of this convulsion,[1]

[1]Jaggar, T. A., 1924, "Sakurajima, Japan's Greatest Volcanic Eruption" *National Geographic Magazine*, Vol. XLV, No. 4, pp. 441–470.

arrived in February to witness the lava outpourings, which joined Sakurajima Island to the mainland of Osumi, while Dr. F. A. Perret, volcanologist, witnessed during February and March the big eruptions from the eastern craters. The resulting ash deposits, which were six feet in thickness near the volcano, thinned down to a mere film thirty miles away, while more than four thousand acres of hard lava were poured out during the first two months of the eruption.

Careful levelings after the eruption showed that old bench marks at the base of the volcano had been upheaved twenty-four feet, while the land all around for a distance of seventy-five miles had subsided, due to the withdrawal from the depths of the earth of the great volumes of ash and lava.

The most outstanding feature of this great volcanic outburst is that no lives were lost except those resulting from a severe earthquake. The ravages of the eruption were also minimized due to the application of scientific knowledge concerning the catastrophe.

The volcanoes which emit lava in greatest volume are comparatively quiet in their action. This is the case with the volcanoes of Iceland and Hawaii, which erupt dark basaltic lavas. Eruptive cycles have been recognized in this type of volcano in Mauna Loa, 13,900 feet high, and Kilauea 4000 feet above the sea, both on the island of Hawaii. Kilauea, being at a lower elevation, is more readily reached than Mauna Loa, and since Prof. T. A. Jaggar established a volcano observatory there in 1911, its action has been studied more closely than that of any other volcano in the Pacific Ocean. Kilauea was discovered in 1823, and except for widely separated intervals of short duration, a "lake" of molten lava is reported to have occupied the central portion of the crater

Photograph by F. A. Perret

THE TERMINUS OF A "MUD LAVA" FLOW

On the upper slopes of a volcano, rain water may seep into fine ash and form a liquid mud. This is much feared after an eruption, for oftentimes it is very destructive

Photograph by F. A. Perret

THE SAKURAJIMA ERUPTION, 1914

Ash clouds of the "cauliflower" type rose to great heights, and houses were buried up to the eaves by this ejected material. Vast quantities of lava also flowed into the sea

Photograph by F. A. Perret

ASH AND STEAM EMISSION AT THE CRATER OF STROMBOLI

From a small but very persistent vent on the east rim of the crater much ash is carried up and can usually be seen falling in showers from the edge of the cloud

Copyrighted Photograph by F. A. Perret

AN ISLAND IN A "LAKE" OF MOLTEN LAVA

The Halemaumau pit in the crater of Kilauea volcano, Hawaii, was filled for many years with a "lake of fire." The hardened lava in the center lasted for several months

until 1894. When first observed in 1823, there was a great pit 1700 feet deep, known as Halemaumau, but subsequently the molten lava rose and frequently welled over the confining walls to stream away over the adjacent crater floor. These repeated upwellings gave rise to a low, flat cone in the region of the central "lake."

The almost continuous activity of this volcano suffered a check, however, in July, 1894, when, with a series of local earthquakes, the molten lava fell rapidly to a great depth in the Halemaumau pit, and by December, 1894, the molten lava had disappeared entirely. It reappeared for short periods prior to 1907, when it resumed a continuously active condition until May 1, 1913. The dormant interval, 1894 to 1907, is of interest in the study of eruptive cycles.

The molten lava, which disappeared into the depths of its pit in May, 1913, reappeared in October, 1913, forming spatter cones, boiling pots, and areas of overflow, at the bottom of the pit. Then it gradually raised its surface in a fluctuating way until October, 1914, when a molten "lake" again appeared. This condition, with fluctuations in height and vigor of surface action, prevailed until May, 1924, when Kilauea exploded. This event according to Professor Jaggar[1] came near the end of a cycle that began in 1913. The cycle reached its culmination with lava outpourings on both Mauna Loa and Kilauea, and declined after 1919 with a succession of sudden lava sinkings and enlargements of the Halemaumau pit. Since 1924 prolonged quiet has ensued.

The amount of rock removed by the May, 1924, explosion, as noted by Professor Jaggar, was 28 million cubic feet, while that removed by engulfment was

[1]Jaggar, T. A., *Bulletin, Hawaiian Volcano Observatory*, Vol. XII, No. 12, pp. 117–122, December, 1924.

Photograph by F. A. Perret

TELEPHOTO VIEW OF THE ISLAND SINKING INTO LIQUID LAVA

Frank A. Perret, the volcanologist, leaned far out over the edge of the Halemaumau pit, Hawaii, to secure this detailed record just before the island sank below the surface of the lava lake

253 times as great. The crater pit was enlarged fourfold not by the attrition and ejection due to gas rushes, but by collapse of the walls into a void below, just as it was enlarged by collapse in 1913, 1918, 1919, 1920, 1921, greatly in 1922, and again in 1923, all without explosions. The May, 1924, explosive eruption was thus merely an incident in a mechanism of engulfment. This event increased the depth of the pit from 400 feet to 1000 feet, and it has been calculated that the shaft, which would hold the rock that was engulfed, must be 8000 feet in diameter and more than 3000 feet deep.

The eruptions of the volcanoes Soufrière and Mont Pelée in the islands of St. Vincent and Martinique, respectively, on May 7 and 8, 1902, furnished a type of activity not previously recognized by volcanologists. These eruptions were characterized by the sudden emission of dense black clouds of superheated and suffocating gases heavily charged with incandescent dust, lapilli, and "bread-crust" bombs, which rose to heights of 12,000 feet and moved swiftly down the slopes of the volcanic cones like a hot avalanche, called *nuée ardente* by Lacroix.[1] According to Perret, the conditions requisite for the formation of a *nuée ardente* are believed to be a pasty lava, very highly charged with gas and so near the mouth of the crater that it might be expelled in the forms manifested at Mont Pelée and the Soufrière. Heilprin, Fenner, and Perret have noted that it is not improbable that a *Peléean nuée ardente* happened during the Plinian eruption of Vesuvius in 79 A.D., during the Katmai volcano eruption in Alaska in 1912, and during the 1914 eruption of Sakurajima in Japan.

No streams of molten lava issued from either Mont Pelée or Soufrière in 1902,

[1]Lacroix, A. *La Montagne Pelée* (1904).

although the ancient rocks show that lava flows alternated with volcanic fragmental deposits, *tuffs*, in the early history of these mountains. The cracked condition of the "bread-crust" bombs and the unusual Mont Pelée spine, which existed in the conduit for a year previous to crumbling, show, according to Hovey, 1902,[1] that partially melted masses of gray andesitic rock existed in the throats of these volcanoes. Little is known concerning the previous activity of Mont Pelée, in 1762, 1851, and the Soufrière in 1802. There were no lava flows at those times. This fact is in harmony with an observation of Leopold von Buch, 1774–1853, that the active volcanoes in the Andes have no free flows of lava.

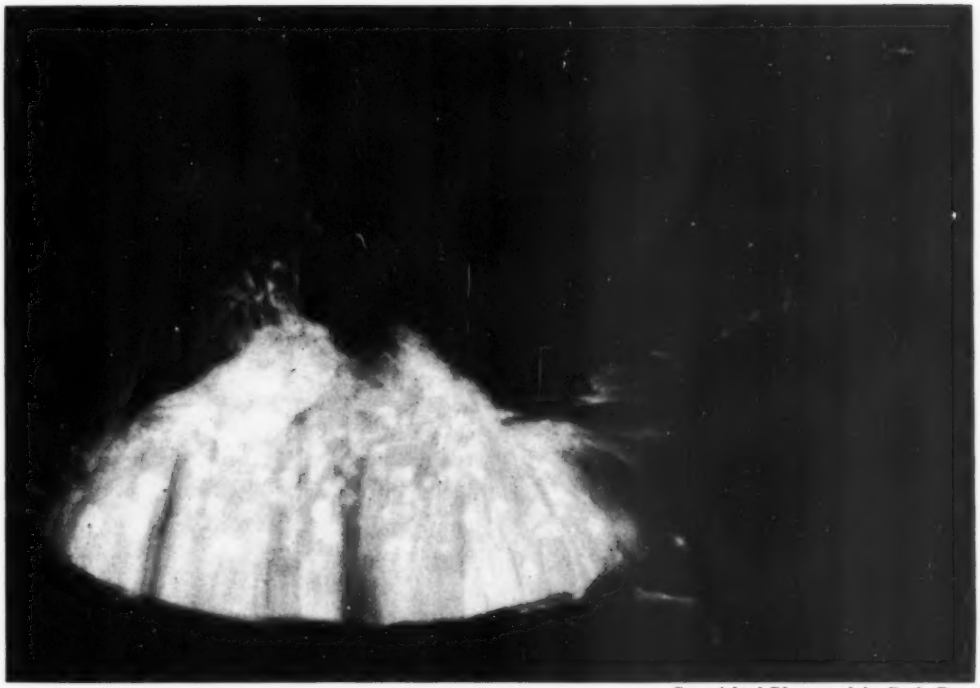
The deadly effect of the Peléean blasts in Martinique and St. Vincent, which killed, within a few minutes, some 42,000 people, seems to have been due chiefly to the irritation of the mucous membrane of the respiratory passages by the fine hot dust. Those persons near the Soufrière, who took refuge in cellars, and the one prisoner in the dungeon at St. Pierre, escaped with their lives.

Vesuvius, in Italy, is the world's best known and most fully studied volcano. Of the period prior to the Christian era, little is known concerning the activity of this volcanic vent. The Greek geographer, Strabo (B.C. 63–A.D. 24), believed it to be a volcanic crater, though extinct. In his day the present complex cone with its Atrium and partial Somma, did not exist, instead only the complete outer ring, the Somma. The terrific outburst of 79 A.D. was on such a grand scale that it constitutes one of the most oustanding events in the history of this volcano. The explosion was so tremendous that the greater portion of the cone, the Somma ring, was blown into bits. No streams of lava issued forth, but such a vast quantity of lapilli and ash that the city of Pompeii, to the southeast, was covered in places to a depth of 25–30 feet, and Herculaneum, to the southwest, was buried by a flood of mud and ash to a depth of 60 feet. These latter deposits have been covered by lava streams of more recent eruptions. From a study of the rocks in the Monte Somma remnant, Johnston-Lavis, 1891, determined a record of fourteen periods of eruption and two long intervals of repose preceding the Christian era.

Between 79 and 1631, eight eruptions of Vesuvius are recorded, but little is known concerning them. Except for a slight outburst of ash in 1500, there was a long period of repose, 1139 to 1631. During this interval, the crater was forested and overgrown with vines, as it had been for a long time previous to 79 A.D. Following this long period of repose, a great explosive eruption occurred in December, 1631. This outburst began on December 15 with rumblings within the crater, followed by an opening of a cleft upon the east side of the mountain, and the emission of steam and ash. On the following day, another fissure opened on the south side, from which steam and ash burst forth to overwhelm four nearby cities. On the 18th, four great streams of lava poured from the crater, three of them reaching the sea. Eight towns were overrun by these lavas and 3000 persons lost their lives. This eruption reduced the height of the cone by 170 meters.

Since 1631 five major eruptions have occurred, namely: 1737, 1794, 1822, 1872 and 1906; also ten minor emissions, to wit: 1834, 1839, 1850, 1855, 1861, 1878, 1899, 1903, and 1913. During this period of almost 300 years a more nearly continuous form of activity has prevailed with explosive and effusive factors more nearly equal in proportion. The conduit of Vesuvius remained open throughout most of the time intervening between

[1]Hovey, E. O., 1902. Martinique and St. Vincent, A Preliminary Report upon the Eruptions of 1902. *Bull. Amer. Mus. Nat. Hist.*, Vol. XVI, pp. 333–372, 18 plates.



Copyrighted Photograph by F. A. Perret

THE BURSTING OF A GAS BUBBLE

In the active liquid lava lake of Kilauea, there will often rise from a vent at the bottom a swarm of great gas bubbles. These rise rapidly to the surface, lifting the heavy, incandescent liquid in a boiling dome of exquisite beauty, throwing out scattering jets, and sending blue-green flames into the air. This is "Old Faithful," more than thirty feet in height

these later eruptions, thus causing a diminution and virtual elimination of the severe seismic disturbances which formerly, at the time of an eruption, affected the immediate region so disastrously.

The 1906 eruption of Vesuvius is of special interest not only because it passed through three phases of an eruptive cycle, but since it was carefully studied by the officials of the Vesuvian Observatory one of whom, Dr. F. A. Perret, an American, has written a full account of those eventful days.[1] Other volcanologists, chiefly French, German, English, and American, have also described this activity; hence, it is one of the better known of the Vesuvian eruptions. It would be a pleasure to give here an extended review of Perret's work, but the allotment of space permits only an abridged account of the three phases of activity.

First Phase.—Following a progressive fissuring and demolition of the upper portion of the cone on April 4, molten lava issued from the side of the crater and the ash cloud rising from the volcano in fairly dense, dark volutes, assumed a threatening aspect. The crater-cloud, carried over the city of Naples and nearby towns, produced a rude awakening to the seriousness of the situation. Neapolitans on the 4th and 5th went about with umbrellas opened against a dry rain of coarse, grayish-black volcanic sand.

The volcano presented an imposing spectacle, not unlike that of a gigantic locomotive puffing up a heavy grade and being constantly supplied with fresh fuel. The eruptive material of these first days

[1]Perret, F. A., 1924, "The Vesuvian Eruption of 1906," Publication No. 339, *Carnegie Institution of Washington*, pp. 1–151.

was coarse in texture and dark in color, consisting mostly of cone detritus. The product was spread in many directions, some towns receiving an average of 90 centimeters, others 30 centimeters. Had the ash been deposited in one direction, that sector would have been buried more completely than was Pompeii in 79 A.D., which was spared this time.

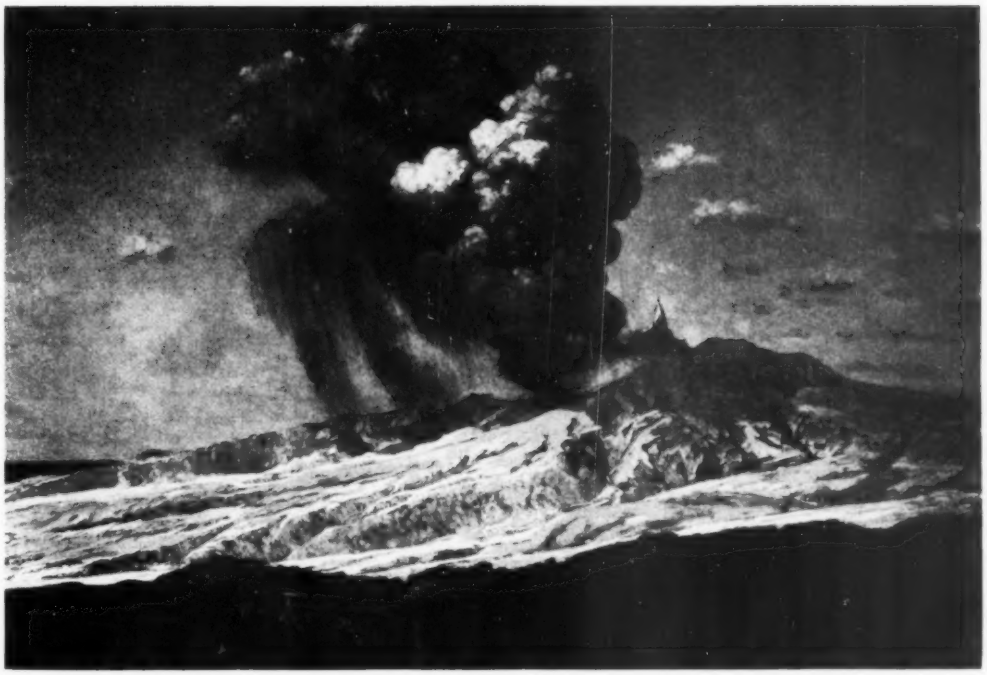
Great flows of lava continued throughout the night of the 5th, and on the morning of the 6th a new lava vent was formed, which gave forth a very rapid outpouring. The activity in the crater also increased to an even greater degree than on the preceding day. The ash of April 6 was of a much finer texture than any hitherto emitted, and the electrical discharges in the crater-cloud were also longer and far more powerful, with an occasional reverberation like ordinary thunder. By midnight all the phenomena had increased in intensity, with sure and repeated demonstrations of greater gas-content in the magma and progressively more active gas-release from the volcano. The magma, which had formerly occupied a lower level in the throat of the volcano, now rose to take the place of that which had been emitted. Nothing could be clearer than the thrice repeated revelation of a rhythmic uplift of magma to higher levels, pulsing in surges of ever increasing amplitude, with consequent liberation of their stored-up energy in the production of the dynamic paroxysms. The instruments at the Vesuvian Observatory continued to indicate seismic activity of constantly increasing magnitude.

On April 7 the dynamic activity at the crater took the form of a series of very sharp, sudden, but powerful explosions in rapid succession, there being at times as many as three per second, with an average of one every two seconds. The material ejected was of a mixed nature, about equally divided between fresh liquid lava and the dark detritus of the crumbling cone. At the instant of each explosion a luminous arc would flash upward and outward from the crater and disappear into space. This phenomenon may be considered one of the most beautiful of all volcanic manifestations.

From time to time there were great explosions having a tearing and roaring sound, "*the boati*," with sensible air-concussion, and the panic among the inhabitants of the Vesuvian towns was great. At night, masses of cone-material were mixed with the incandescent jets, while brilliant electrical discharges pierced the dark detritus clouds. At times, the pillar of liquid fire, maintained at a height of several kilometers, would illuminate the Gulf of Naples from Capri to Miseno.

After midnight of the 7th there was a continuous earthquake and, for some hours, it was impossible to stand quite still. The mountain was pulsing and vibrating continuously like the shell of a humming boiler. The most alarming feature at this time was the continuous increase in the strength of the earth shocks above the regular pulsations. A second powerful earthquake at 2:30 A.M., April 8, caused great downfalls at the mountain-top, and from this moment a condition was reached where action, reaction, and interaction combined to effect a release of energy that nothing but exhaustion could bring to an end. The electrical manifestations reached an appalling intensity, and a portion of the great columns of gas, lava, and detritus was shot obliquely to the northeast, covering the cities of the plain with ash to a depth of three feeet.

At 3:30 A.M., April 8, the true dynamic culmination of the great eruption began with a literal *unfolding* outwardly of the upper portion of the cone in all directions, like the falling of the petals of a flower. The mighty uprush of gas liberated from the depths with ever increasing accelera-



ERUPTION OF MONT PELÉE, ISLAND OF MARTINIQUE, WEST INDIES
From a painting by Charles R. Knight after a photograph by the late Dr. E. O. Hovey, 1903

tion was actually coring out and constantly widening the bore of the volcanic chimney. The emanations gradually became less luminous and, with the fall from the skies of fragments of gray rocks torn from the conduit, it was necessary for one to stand erect with a rolled-up overcoat held as a cushion upon one's head. The projectiles, which varied in size from nuts to masses weighing 2 to 3 kilograms, fell as far as 4 kilometers from the crater.

SECOND PHASE.—By daylight of April 8 the seismic movements had diminished in intensity, all the liquid lava had been ejected, and the throat of the volcano was clear, but from a source, the depth of which is unknown, there rushed forth through the central tube a continuous blast of gas, reaching heights as great as 13,000 meters. At the top of the lofty pillar of cloud great globular masses of vapor were expanding outwardly against the surrounding air-cushion with incredible velocity, forming "cauliflower heads" with a sharpness of contour and wealth of detail impossible to describe. That which staggered the imagination was the revelation of stupendous initial pressure. The ash content having been filtered out in the rapid projection of the gas upward, the upper and outer edges of the great "cauliflower" masses were of the purest white and closely resembled condensed steam.

At midnight of April 8 exceedingly powerful electric discharges with long reverberations were heard, indicating renewed injection of detritus into the crater-cloud, and, inasmuch as this could hardly have occurred under the sway of the ultra-powerful blast of gas, there was reason for supposing that this marked the end of the second or "intermediate gas phase."

The earthquakes of the night of April 7 had produced a state of panic at Naples, and it is said that 100,000 persons left the city in five days. At each return of

the crater-cloud, with its darkness and its showers of ash, processions filled the streets, invoking intercession of the saints.

THIRD PHASE.—On the morning of April 9 an imposing volume of ash issuing from a greatly widened crater, but under a reduced gas-pressure, revealed a great change in the nature of the eruptive processes. The last and longest phase of the eruption, the dark ash phase, had arrived, and it behooved Doctor Perret, who had made a hurried trip down the mountain to Naples, to return to his post at the observatory. This he did with difficulty. On the way he saw scenes like those which Pompeii must have witnessed in 79 A.D. The volcanic storm produced darkness equal to that in a tunnel. Human faces peered from doorways, from under wagons, and from every place of shelter. About the observatory the down-sweeping ash became conglomerated with the water vapor in the crater-cloud, forming balls of soft mud, some as large as an egg.

Upon the cone itself "hot avalanches" were observed. This material, representing the accumulation of ejected material upon the upper portions of the cone, was not only intensely hot but, due to the dilated condition of the interstitial gas, and being poised in exceedingly unstable equilibrium, it possessed an extraordinary amount of potential mobility. The extensive repetition of the avalanches on the outer slopes of the cone produced numerous radial furrows, *barrancos*, which remained long after the eruptive period had passed.

On the morning of April 10 the observatory seismoscopes were quite strongly agitated. The crater-cloud was once more sent upward with some force, but in the afternoon it arched over toward the southwest, and swept down the mountainside over Terre del Greco. The electrical discharges within the crater-cloud had ceased, but the cloud itself was strongly electrified as a whole and in opposition to the earth, to which it was powerfully attracted. Doctor Perret and his companions, in passing under this cloud of gas and ash, noted that the electrical potential was so powerful that a "brush discharge" (St. Elmo's fire) was developed on every pointed object. The electrical attraction was still further demonstrated by the violent impact of the coarse grains of sand, which scratched the skin and cut the lips to the point of bleeding. This was the manner in which Pliny, the Roman naturalist and author, died in 79 A.D. On this day the ash-cloud, the smallest diameter of which was 600–700 meters, attained probably its greatest density.

From April 11 to 21, the seismic shocks were frequent and oftentimes strong. During this time the ash fell heavily, producing a series of long periods of obscurity, some lasting for eight hours or more, in which there was absolutely no difference between night and day. The gas emissions of the 18th contained carbon dioxide. This heavy, invisible gas produced a sensation of heat about the feet and legs, indescribable oppression, and a slight difficulty in breathing.

On the 22d the eruption, dynamically, was virtually at a end, as the seismoscopes often stood motionless for hours at a time. The crater-cloud of ash and gas—though still rising majestically and in successive puffs due to soft explosions—had an ascensional power barely sufficient to raise its heavy content of ash. On April 30 all was quiet and Doctor Perret returned to Naples after having visited the rim of the great crater on April 24.

According to Perret there has been a marked periodicity in the modern eruptive process of Vesuvius, each great eruption releasing energy and material which have accumulated during a more or less prolonged period of lesser activity, in spite of occasional temporary relief through minor outbreaks. Then follows a

Photograph by F. A. Perret

BALL-HEADED VORTEX EXPLOSION FROM THE CRATER OF STROMBOLI

After a stoppage of perhaps fifteen minutes the gases burst through the plug to form a rotating vortex with gas sufficient to carry up stones. The rotating vortex at the top throws these stones in all directions

period of repose, due to exhaustion and obstruction, after which the renewed supply of magma—rising slowly from the depths—reëstablishes a vent at the bottom of the crater-basin, and a new active period ensues, completing a cycle. Mercalli, in 1907, called attention to this, and published a list of twelve such periods since 1700, each culminating in a paroxysm followed by an interval of inactivity lasting from two to seven years, with three and one-half years as an average.

Perret, writing in 1922, states that the great 1906 basin of Vesuvius was then filled to within a short distance of the lowest portion of the rim, giving an accessible crater-bottom similar to that of Kilauea, but with a different kind of activity of far greater degree. He remarks that the future behavior of this volcano is a matter of the most intense interest.

The nature of a volcanic eruption, whether "explosive" or "effusive" is assumed generally to be based upon the mere difference of fusibility of the rock emitted. For instance, the eruption of trachytic and andesitic magmas oftentimes produces steep cones of fragmental deposits resulting from paroxysmal outbursts, while the readily fusible basaltic or more basic type gives rise to low, broad cones developed by liquid lavas. Perret suggests that this distinction can be maintained only with great reserve, since the steep volcanic cones are oftentimes built up of lava outpourings as well as of fragmental deposits, while in the basaltic type violent explosive phenomena not uncommonly accompany the molten flows. In fact, each type of magma may show both classes of phenomena. Perret considers that there are other clearly indicated conditions which control the nature of the manifestations, and determine the mode of action during the various phases of an eruption. An important factor is whether the conduit has been normally open or closed during the period preceding the eruption. If closed, the magmatic reservoir will generate and accumulate gas in the liquid material within and beneath the volcanic edifice. When gas, the chief eruptive element, has accumulated in the uppermost magma in sufficient quantity to pierce the crater plug, the prompt release and ejection of all or a part of this matter will constitute eruption.

Perret considers the magma a paste, which permits the transfusion of gas and which changes into liquid lava in the upper part of the column. It rises slowly, and when it reaches the zone of fractured rocks, considered to be some six miles thick, it will be exposed to water and air. The assimilation of these modifying elements has a profound effect upon the physical and chemical activities and upon the prolonged existence and repeated functioning of the volcanic vent.

Perret states that the subdivision of the magma, when it is more or less forcibly ejected, will depend upon the nature of the material, its physical condition at the moment of emission, and especially its gas-content. Since such material cannot flow in a coherent stream, it will be shot upward by the powerful gaseous expansion as finely divided ejecta. When material from lower levels in the conduit comes to the surface, it may take the form of "bread-crust" bombs, exploding magma-masses forming *nuée ardentes* or gas-free matter extruded as domes, spines, or viscous flows. Closed conditions of the lava conduit preceded the famous eruptions of Vesuvius in 79 and 1631, and the Mont Pelée and Soufrière outbursts in 1902.

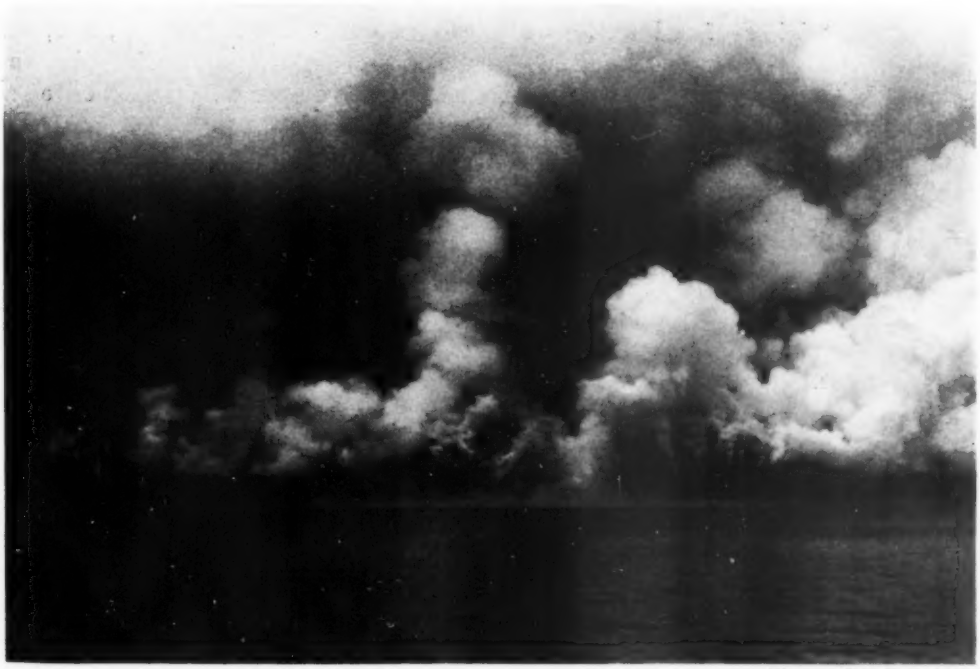
When the conduit is open and free, the magma shows a different condition, especially in the upper portion of the column. Perret states that the upstreaming of gas with heat-carrying properties induces a powerful churning and stirring effect, and in spite of exposure to radiation, conduc-

tion, and loss of heat, it maintains the magma at a high temperature. So nearly perfect is the state of equilibrium between gas tension at the magma surface, and the weight of the atmosphere, that any variation of the latter reacts upon the rate of gas evolution with noticeable increase or diminution of the volcano's activity. This is especially noticeable at Stromboli.

At lower levels, a condition exists which is almost equivalent to a closed conduit. Due to the pressure of superincumbent material, the gas is retained and accumulates, forming a potentially explosive magma. Under such conditions successive zones of potentially explosive magma may arise in the magmatic column. When the gas accumulation has reached the point of saturation, all that is required to cause a great eruption is the intervention of some factor that is capable of disturbing the existing state of equilibrium.

This may be brought about by fracture of the wall of the conduit, resulting in lateral outflow and drainage sufficiently rapid and copious to materially reduce the liquid in the tube. The pressure on subjacent zones thus being relieved, a progressive process of expansion, rise, and expulsion will continue until the paroxysmal liberation of gas from the surcharged lower layers culminates in the outbreak, and exhausts the accumulation of energy and material. Then follows the cyclical interval of repose and renewal.

So mightiest powers by deepest calms are fed,
And sleep, how oft, in things that gentlest be!
—Barry Cornwall.



Photograph by F. A. Perret

LAVA ENTERING THE SEA

When the material is sufficiently hot, a protecting skin is formed upon coming into contact with water or snow. The molten lava will then flow along the sea bottom without any disturbance at the surface other than the steam clouds of the first contact. Scene along the Japanese coast during the eruption of Sakurajima, 1914

Panoram of Mounts Kukenam and Roraima photographed from a distance of about six miles

THE "LOST WORLD" OF MOUNT RORAIMA

The Account of an Expedition to a Strange and Little Known Flat-topped Mountain in the Heart of the South American Jungle

By G. H. H. TATE
Department of Mammals, American Museum

Photographs by G. H. H. Tate and T. D. Carter

TWENTY square miles of rough and rocky plain, carved by centuries of rainfall into a maze of gullies and rifts, masked by almost constant fog and mist—a bleak, forbidding island, in the far interior of the South American wilds, cut off from the world not by water, but by sheer precipices of red rock twelve hundred feet high that ring it round on every side. This is Roraima, the "Lost World" that Conan Doyle's vivid imagination filled with teeming broods of dinosaurs and pterodactyls.

This, too, is the "Father of Streams," whose vast bulk and personality dominate and shape the thoughts and lives of every Arecuna Indian for fifty miles around. Roraima—old and grim when Manhattan was yet buried deep beneath the glaciers of the last Ice Age—older and perhaps a little grimmer now, frowning down upon the surrounding South American wilderness with a cold inscrutability that has been a lure to the scientist and explorer ever since its discovery by Schomburgk in 1841.

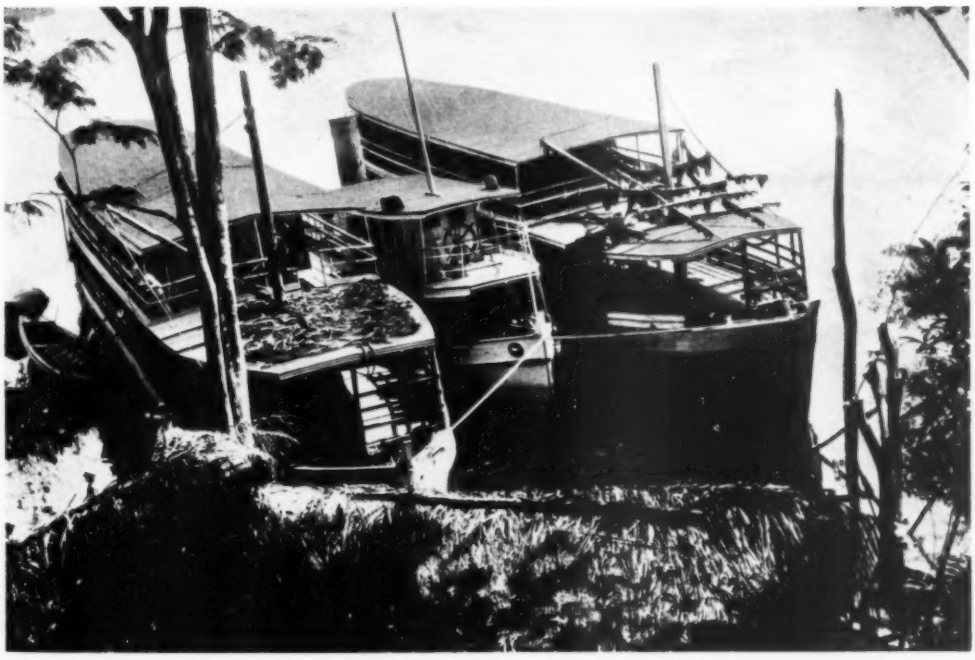
The ledge leading to the top of the mountain is, for most of its length, broader than Fifth Avenue, New York; but it is a Fifth Avenue tilted on its side—inclined so steeply that cars and omnibuses would turn turtle and roll over the edge of the precipice. Besides having this rather inconvenient slope, the path is studded with rocks and buttresses and charred remains of forest.

The top of Roraima is, roughly speaking, level, although when we started to explore it, we found the entire surface carved and fretted into gullies, rifts, and castellated cliffs, balanced rocks and mushrooms on pedicels, and tables set on thick stone legs.

It was on October 21, 1927, that we pitched our camp at the base of Mount Roraima, after penetrating to the foot of its tremendous precipices in the interests of the American Museum of Natural History. Our expedition, which consisted of Mr. T. D. Carter, my brother Geoff, and myself, had been made possible through the generosity of Mr. Lee Garnett Day, who contributed the "sinews" for our assault upon this huge natural stronghold. Furthermore, we had been greatly assisted by the "free entry" accorded us by the Brazilian officials at Pará and by our pleasant association, later on our journey into the interior, with General Candido Mariano Rondon and his staff of officers, with whom we traveled to the base of the mountain that was our goal.

For three weeks we camped at the foot of Roraima, watching the clouds as they

"CAI EN AGUA"
All hands overboard to force the boat past a difficult rock



MEANS OF TRAVEL ON THE RIO NEGRO
The boat in the center supplies the motive power for all three. At short intervals stops are necessary in order to obtain wood from the wood piles that are kept stocked by natives ashore. The objects hanging from the lines are not laundry, but strips of beef drying in the sun

swirled about its summit—studying, collecting, observing with all our energy. Then, on the 16th of November, we made our way up the bowlder-strewn incline that is the only route to the top, and after a strenuous day, pitched our little camp among the strangely shaped rocks of that extraordinary place.

The cold light of our first daybreak on the summit of Mount Roraima filtered through the thin material of the tent and awakened me. At moments through the night I had been conscious of gusts of wind and rain tearing and lashing at our little shelter; but now the wind was still, the rain had ceased. Lying quietly on my cot, I reached up with one hand and pressed against a heavy sag in the canvas just above my head. The water rushed from the tiny lake to the ground.

I shouted to awaken my companions. Unintelligible grunts came from two heaps of blankets on neighboring cots, and the pup, Sunny, emerged from beneath my bed, yawned prodigiously, and stretched his limbs front and hind.

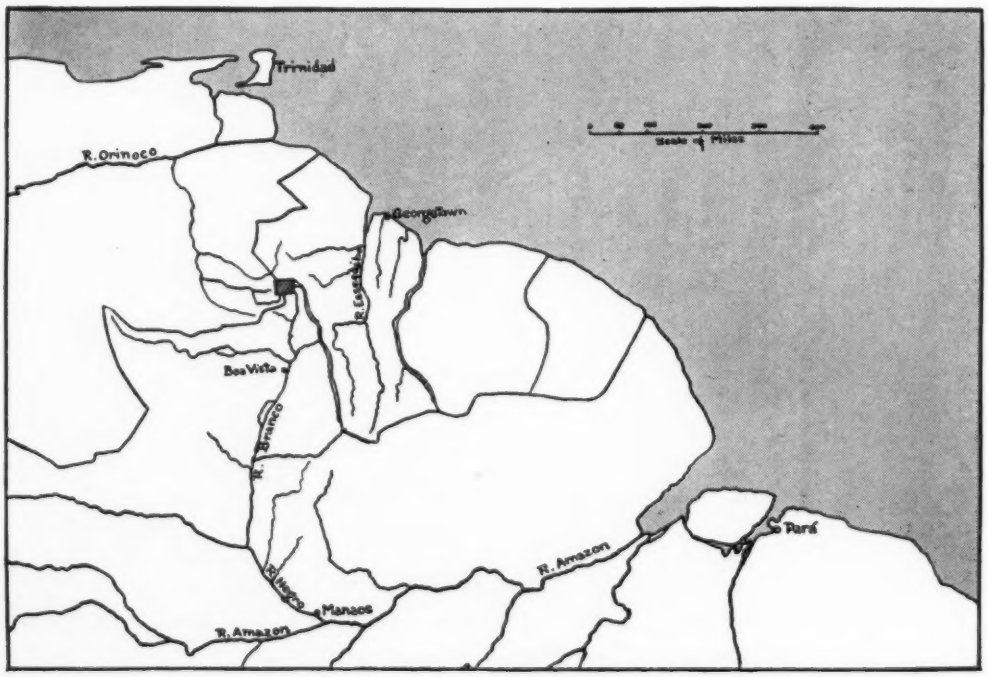
I struggled uncomfortably into clothes that were chill and clammy, fastened back the door flaps, put my head out, and shouted in the general direction of the kitchen tent.

"Adolfo! Are my shoes dry?"

"Sim, senhor."

Adolfo's answer was always in the affirmative, no matter what question I asked. Picking his way over the soggy ground, he brought me a pair of slightly warm, but still saturated objects that were once basket-ball shoes.

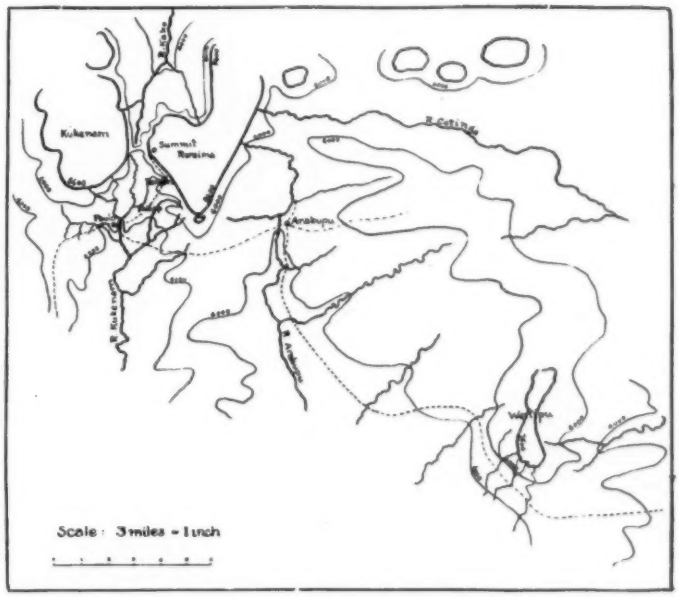
The mercury stood at fifty-one degrees; my two aneroids registered an average of 8600 feet above the level of the sea. The mist, eddying and billowing among grotesque rock masses all about, brightened to pearly white as the rising sun



THE SQUARE MARKS RORAIMA AND THE AREA WHERE THE EXPEDITION WORKED
The expedition journeyed up the Amazon to Manaos, and thence up the Rio Negro and the Rio Branco. Returning, the men traveled down the Rio Essequibo to Georgetown, British Guiana

gathered strength. Sounds of activity came from the tent behind me; so, shivering, I crossed by improvised stepping stones over a few feet of boggy ground to the large notch in the sandstone where we had our kitchen and work tents.

This spot, by the way, is the identical one where Mr. and Mrs. Clementi spent their one night on Roraima thirteen years ago. A little brass plate bearing their initials and the date is still firmly cemented in the rock.



THE VICINITY OF RORAIMA
Showing the five camp sites of the expedition. These represent altitudes between 4000 feet and the summit, 8600 feet

As I stooped at the edge of the cook-house tarpaulin, a cloud of acrid wood smoke blew full in my face, and I realized that José, our combined cook and animal trapper, had emerged from his nocturnal torpor, and was preparing oatmeal and coffee.

"Bom dia, senhor."

"Good morning, José. Be quick with that breakfast."

I passed on to the second shelter, which served both as laboratory and dining room. Its floor had been raised above the mire by roughly paving it with rocks, and although the stonework kept our feet dry, it was difficult to place a camp chair so that it rested on more than three legs. I finished entering my weather records just as Don and Geoff came in, and a few minutes later we sat down to breakfast.

The meal over, I whistled to Sunny and started out to explore the rocky basin at the edge of which we had pitched our camp. The fresh herbage with the glint of raindrops on it was entrancing, and the many new (to me) varieties of plants delighted me. Yet, too, what a bleak, remote aspect had this place where no man had set foot for more than half a score of years.

I strolled slowly, picking my way among age-old rocks separated from one another by ruts and trenches filled by swamp herbage. Here were spiky-leaved *Xyris*, mats of pitcher plants, pipeworts, and sundews. Farther along was a hollow where the water stood knee-deep nearly covering great masses of sphagnum moss. The chief plant of these depressions, though, was *Bonnetia*, a stunted, gnarled little tree with small reddish-green leaves and a sprinkle of white flowers. Its base was hidden deep beneath the sopping sphagnum. The only firewood on Roraima is furnished by *Bonnetia*. According to Quelch, a previous visitor, the *Bonnetia* sometimes reaches a height of thirty-five feet. I fear he must have chopped that one down. Fifteen feet is about the limit.

I stood and watched Sunny. Breast-

FORDING THE MIANG RIVER
The Indians who served as porters for this portion of the journey were of the Macuxi tribe

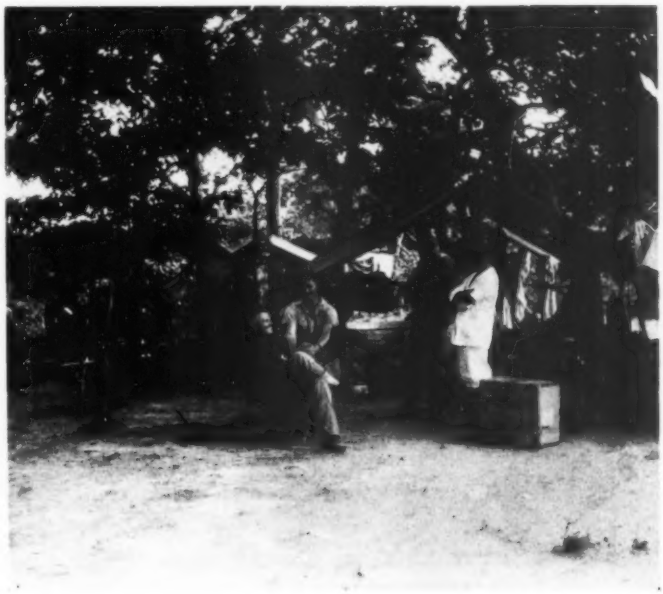
deep in a pool and nearly motionless except for his tail, he was gravely intent upon his efforts to tread on the plump but agile dragon fly nymphs abundant in every pond.

Near by, at the foot of some cliffs where grew a fair profusion of vegetation, were a few little runways and signs that at least some sort of small animals were at home on the summit. At rare intervals, too, birds hopped and chirped, it seemed to me rather disconsolately, in the branches of the *Bonnetias* and bushes among the rocks. The only common kind was McConnell's song-sparrow.

The sun shone out as I crossed a level stretch of sandy swamp dotted with sedges and sundews, and I saw Sunny racing toward me apparently pursuing a butterfly. It was soon plain that he had mistaken the shadow for the substance, for he was much puzzled when the insect, a black *Satyrid*, floated over an eight-foot rock and its shadow suddenly vanished.

In camp I found Don, who had also been "sizing up" things. He had seen a pair of the rare *Diglossa* honey creepers. While he was watching them hop about among the bushes, they suddenly disappeared. He was not greatly perturbed at neglecting to shoot them, for he concluded that he could easily obtain others.

AN ARECUNA INDIAN
Hanging to the pole is a prehensile-tailed anteater which this native brought alive to the expedition's camp at the foot of Roraima



AFTER LUNCH AT THE CAMP OF GENERAL RONDON

General Candido Mariano Rondon, while making a border survey for his government, visited Roraima, and the American Museum expedition was fortunate in being able to travel with him

As a matter of fact, though we caught glimpses of one not infrequently, he collected only one on the last day of our stay on the plateau. Their real home is in the forests at the base of the cliffs, where we caught many.

Don and Geoff had explored to the east of the camp, and had worked their way among great rocks and bowlders and among bog-filled crevices to the crest of a low range of sandstone hills. Their objective had been a point which we named the "Tiger's Ear," and which served subsequently as one of the chief landmarks for our compass survey.

Assisting each other, they had managed to climb up the "Ear" and tie there a slender pole to which was fastened a flag made of handkerchiefs.

I set José and Adolfo promptly to work baiting traps, as I wished to set as long a line as we possibly could before nightfall. We used the common guillotine rat traps in two sizes. For bait we carried with us a composite mixture of rolled oats, bacon, raisins, and peanut butter—all ground up quite finely and intimately mixed together. Such sumptuous fare was a temptation that a "coun-

MR. TATE (LEFT), THE LEADER OF THE EXPEDITION

With his brother and the party's mascot on board the scow in which, with the aid of two outboard motors, they navigated the Rio Branco. One of the motors had a habit of catching fire

A VIEW FROM THE TOP OF RORAIMA

The mist almost constantly welled up the perpendicular cliffs and kept the party shivering and depressed. Sunshine was rare and photography was exceedingly difficult

A VIEW FROM THE CAMP AT THE BASE OF RORAIMA

Philipp Camp, from which this picture was taken, was only two miles from the base of the cliffs, whose crests towered 3400 feet above the tent shown in the foreground

CAMP ON THE SUMMIT OF THE MOUNTAIN

The low places between the rocks were soft and miry; except for these boggy spots, the surface of the flat-topped mountain was rocky and exceedingly rough

THE "LABORATORY" AND "DINING ROOM"

Adolfo, whose specialty was trapping and skinning, is shown here with part of a day's catch. The laboratory served also as a dining room, and at mealtimes the bottled frogs and pickled centipedes were removed from the table and were replaced by beans, rice, and coffee

A FALCON FROM FRECHAL

(*Above.*) This little bird bears the scientific name *Cerchneis sparveria distincta,* but was much more handicapped by a slight wound in one wing

MR. CARTER WITH TWO SMALL CAPTIVES

(*Right.*) Some maneuvering was necessary before the two birds consented to pose. The owl was used as a decoy by his Indian owner

try mouse" could seldom resist. Indeed, I felt sometimes, to judge from its rate of consumption, that perhaps José felt it sinful to waste such a repast on mere rodents. This follower of ours hailed from Iquitos in Peru, and a meeker, milder soul I have seldom encountered. Yet he was a prudent individual. It cut him to the heart to see anything thrown away. We had to use stealth to get rid of even a used tomato can, for he invariably retrieved every object he could find. Some months later, when we left Roraima, José staggered under a load of salvage that would have daunted even one of our Indian porters.

In the "Lost World" the silence seems to have a quality that produces a numbing, oppressive effect on the senses, so that setting traps out alone somewhere in that cold rain becomes anything but a pleasant occupation. Yet, a large number of our "out-of-sights" were lying in wait by little highways when night fell.

In the morning, when I looked at my traps, I felt well rewarded for the months spent in traveling to our goal, for there were several specimens of *Thomasomys mcconnelli,* the queer little mouse that has appropriated Roraima's summit and slopes for its homeland. In one of the last traps, set deep amidst reeking cushions of sphagnum moss and a tangle of low-growing bushes, lay a different creature

A BELL BIRD (*PROCNIAS VARIEGATUS*) OF THE RORAIMA FOREST

(*Below.*) Its ringing notes seem almost to originate at some blacksmith's anvil. The wattles of the handsome creature look very much like a beard

—a little, shrewlike animal with a long, pointed snout.

"*Cœnolestes*," I exclaimed aloud, although I was quite alone. *Cœnolestes* is a strange "living fossil" marsupial of the high Andes, and its occurrence on Roraima would have been of the highest interest. The new animal, as it lay dead in the trap, looked the very picture of one. Its teeth, however, proclaimed it a rodent. Tiny eyes, no bigger than a pin's head, suggested that sight might not rank very highly among its senses. Hearing, smell, and taste, on the other hand, were without doubt acute. And what a coat! Beautiful, soft, lax fur that brushed in any direction—fur so long in proportion to the creature's size that even a prize Persian cat might be filled with envy. Back at the "lab" I exhibited it gleefully.

BELL BIRD AND OWL

(*Above.*) The larger of the two seems somewhat perturbed by the presence of the other

A SOUTH AMERICAN OPOSSUM

(*Left.*) This creature is allied to our Virginian species, but has a longer tail. Captured in dense forest near Arabupu

A TINY OWL OF THE GENUS *GLAUCIDIUM*

(*Below.*) This bird was a pet of one of the Indians of the party. Its size is better shown in the picture at the top of this page

As the days passed, we learned the best routes for crossing rapidly to the center of the plateau. Where before we had spent hours clambering through intricate labyrinths of sculptured sandstone, jumping across great cracks that every few minutes appeared before us, or feeling our way over rather treacherous bogs in the deeper hollows, now we could take the easiest paths well afield, and thence strike out still farther. Moreover, we now knew our way well enough to be independent of the mist. In that way we reached the southern point of the mountain and Gun Rock at the southeast of the Great North Bay.

In the evenings, when the fog closed

down and the pelting rain increased, we returned to camp. And José and Adolfo, having finished the day's skinning of birds and animals, would be crouching quietly over the fire in the gathering darkness, engaged in preparing beans and rice for supper. One of us would pump up the reservoir of our gasoline lantern. Then, with the light shining on the dank rock walls at either end of our tarpaulin, we would sit down to our appetizing food.

An important part of the table setting was my cyanide killing-jar, with which I rose at intervals during the meal and captured unwary night-moths and errant daddy long-legs that paused on the canvas ceiling.

KAIETEUR FALLS

The Falls, more than four times as high as Niagara, can rarely be photographed because of the mists enveloping them

Meanwhile José and Adolfo would profit by the light to spread their blankets on a thick couch of *Bonnetia* twigs and leaves, and would complete their last duty of the day—the preparation of cups of steaming-hot cocoa, which we drank just before retiring.

Such days were typical of the twenty-one we spent on Mount Roraima. Soaked by rain and mist, balked in our photography by the clouds that seemed constantly to hang over our rocky surroundings, we nevertheless were able to collect more than 200 species of birds, mammals, invertebrates, and plants. As yet we cannot tell how many of these have never before been described, but we feel confident that the number will be considerable and that our journey to the "Lost World" of Roraima will have proved worth while.

NOTES

ASTRONOMY

At the first annual meeting of the Amateur Astronomers Association, held May 17, the following officers were elected: President, G. Clyde Fisher; Vice Presidents, Stansbury Hagar; George A. Galliver; Dr. Oswald Schlockow; C. W. Elmer; Secretary, M. Louise Rieker; Treasurer, Charles J. Liebman.

In coöperation with the Nature Trail of the American Museum at Bear Mountain, Palisades Interstate Park, the summer activities of the Association will include a series of Saturday evening meetings at 8 P.M on the lawn at Bear Mountain Inn. The speakers as scheduled are:

June	2	Mr. Stansbury Hagar, "American Indian Legends of the Celestial Bear and Mummy."
"	9	Dr. Clyde Fisher, "The Discoveries of Galileo."
"	16	Mr. Charles J. Liebman, Jr., "Saturn and His Rings."
"	23	Mr. G. H. Lutz, "Telescope Making."
"	30	Mr. H. D. Benner, "Know Your Stars."
July	7	Dr. Oswald Schlockow, "Daily and Annual Movements of Stars and Planets."
"	14	Mr. Frank Reh, "A Journey Through Space."
"	21	Dr. Clement S. Brainin, "The Changing Stars."
"	28	Mr. S. L. Toplitz, "Locating Direction by Constellation other than the North Star Group, Ursa Minor."
Aug.	4	Mr. Cornelius Wolff, "The North Circumpolar Constellations."
"	11	Mr. Paul Shogren, "Phases of the Moon."
"	18	Mr. C. W. Elmer, "The Meridian Constellations."
"	25	Mr. William Henry, "Sun Spots."
Sept.	1	Mr. Max Lipkind, "Shooting Stars."

Summer activities will also include meetings at the North Star Altar, on the grounds of the American Museum, 77th Street and Central Park West, New York, on Tuesday and Thursday evenings, under the direction of Mr. H. D. Benner and his associates.

EDUCATION

In accordance with the policy of the Museum's department of education, to give the pupil teachers of the Training Schools an opportunity to become acquainted with the facilities which the Museum offers to teachers, receptions were held for the faculties and graduating classes of the New York Training School and the Maxwell Training School on June 11 and 14 respectively.

The Association of Teachers of Blind and Sight Conservation Classes, also were entertained on June 5.

There were illustrated talks in the auditorium, followed by a short tour of the Museum and the School Service Building. The groups reassembled at four o'clock in the North Bird Hall for afternoon tea and a little social gathering.

MUSEUM COURSES AT COLUMBIA.—Realizing the need of systematic training for Museum workers, Columbia University is offering two summer courses in Museum training on its curriculum. The aim is to give both a theoretical and a practical knowledge of the principles upon which new museums are established, old ones reorganized, and progressively better methods worked out for all. These courses are designed for directors in museums outside the great museum centers, for assistants needing a general view of museum administration, for curators of art galleries, custodians of historical museums, and for the young college graduate who has specialized in art, anthropology, science, or the history of civilization.

EXPEDITIONS

THE AMERICAN MUSEUM TANGANYIKA EXPEDITION.—The Museum's collections of African birds are to be increased by the results of an expedition now being planned by Messrs. J. Sterling Rockefeller and C. B. G. Murphy, of Yale University. Leaving New York at the end of June for a short hunting trip in Tanganyika Territory, Messrs. Rockefeller and Murphy will be accompanied by Mr. Allan L. Moses, the well-known bird-collector of Grand Manan, who has already worked in West Africa as a member of the Cleveland Museum Blossom Expedition. After a visit to the famous big-game country of East Africa, the entire party will devote its attention to the avifauna, proceeding to Lake Tanganyika and the adjacent highlands of the Belgian Congo. Thus, besides adding to the representation of birds from eastern Africa, the expedition aims to complete the ornithological survey of the Belgian Congo, which the American Museum, in coöperation with the Musée du Congo Belge, has been carrying on since 1909.

THE SCIENTIFIC WORK OF COMMANDER RICHARD E. BYRD'S FORTHCOMING EXPEDITION to the Antarctic is to be under the auspices of the American Museum. A special room has been set aside in the School Service Building as scientific headquarters of the expedition, and experts of the Museum staff will assist Commander Byrd and his staff in outlining a program of scientific activities.

Prof. Henry Fairfield Osborn gave a luncheon at the American Museum June 4, in honor of Commander Byrd. The most recent Antarctic maps of the region Commader Byrd will explore, and literature on recent Antarctic exploration compiled by Scott, Mawson, Amundsen, Shackleton, and Charcot, as well as the final publications of the British Antarctic Expedition of 1910–13,

the National Antarctic Expedition of 1901–04, and the French Antarctic Expeditions of 1903–05 and 1908–10 were on display at the luncheon, and will be exhibited beside the model of the south polar regions, which has been installed in the Memorial Hall of the Museum. Among the guests at President Osborn's luncheon were Commander Fitzhugh Green of the Crockerland Expedition, who reached the scene of the supposed Crockerland; Dr. Robert C. Murphy, who directed two expeditions to the Antarctic; Dr. Chester A. Reeds, head of the department of geology; George Palmer Putnam; Director George H. Sherwood; Dr. Charles H. Townsend; Earl Dodge Osborn; and Wayne M. Faunce.

THE CENTRAL ASIATIC EXPEDITION cables that it has reached the Shara Murun Beds, 350 miles from Kalgan. Also that Dr. Roy Chapman Andrews had been accidentally shot in the leg, but that fortunately the injury was not permanent, and Doctor Andrews is recovering satisfactorily. He has therefore remained with the expedition, which will leave shortly for the Gobi Desert. The leaders are optimistic about the work for this season.

The *Birmingham Post* of April 17, 1928, in commenting on the departure from Kalgan of the Central Asiatic Expedition, says:

"First catch your brigand, then take him," seems to be the motto of the scientists exploring the Central Asian plateau. Today, Mr. Roy Chapman Andrews of the American Museum of Natural History left Kalgan at the head of the Central Asiatic Expedition after having made full forward arrangements with brigands who infest Mongolia, that the work of the expedition should proceed without hindrance.

This is the fourth expedition Mr. Andrews has led into Mongolia. On the last occasion he brought back the famous dinosaur eggs. . . . Following a very interesting discovery near Peking, he and his fellow scientists are out to look for human remains older than the Java Ape Man discovered last century by Dr. Dubois. The interesting discovery referred to was made last summer by Dr. Davidson Black, of the Peking Union Medical College, in the Western Hills twelve miles from Peking. It was an ancient human tooth as old as the Java Ape Man and possibly older, according to Mr. Andrews, and has been named Sinanthropus, or the Peking Man.

"This," said Mr. Andrews, is probably the oldest and most important piece of human remains yet discovered. It is at least a million years old, and possibly older. Its discovery has been an enormous stimulus to the expedition, and shows we are on the right track. . . .We are going to search strata and deposits of the oligocene age which, a few years ago, would have been thought far too old to contain human remains.

The expedition left Kalgan in eight three-quarter ton motor-lorries, and consists of ten foreigners and 26 Mongols and Chinese. The caravan consists of 125 camels, carrying petrol, scientific equipment, and food for six months for 36 men.

THE STOLL-MCCRACKEN SIBERIAN ARCTIC EXPEDITION has on two occasions been in touch with radio receiving stations in the United States. One message, received May 15, stated that the "Morrissey" was heading across the Gulf of Alaska for Isanotski Straits and Port Moller, and that all were well aboard.

On May 22 the schooner had entered Bering Sea through Unimak Pass after a delay of two days behind Unimak Island, due to storms. Here Father Demetrie Hotowiski, the famous Alaskan Russian priest and big-game hunter, joined the expedition.

FOSSIL VERTEBRATES

DR. W. D. MATTHEW, professor of palæontology at the University of California, is making a two months' visit to the American Museum in order to continue his studies of its Paleocene collections. Doctor Matthew began these studies while curator of vertebrate palæontology at the Museum.

INSECTS

THE DEPARTMENT OF INSECT LIFE has been greatly strengthened by the appointment of Mr. C. H. Curran as assistant curator in charge of Diptera. This group of insects, which includes flies and mosquitoes, contains more than twice as many species as there are of all vertebrate animals, including birds and fishes. Consequently there is a great need for curators in this field.

RECONSTRUCTION WORK, made necessary by the doming of the Mammal Hall, has started in the Insect Hall. Eight habitat groups are being reinstalled and provision is being made for twenty-four more. At the same time a long-desired change in lighting is being carried out. According to the new plan each case throughout the hall will be individually illuminated from within the case, making it much easier to see the small specimens on exhibition. It is hoped that the hall may be in presentable shape when the meeting of the International Congress of Entomology is held in August.

PROSPECTS ARE BRIGHT for a very successful season at the Museum's Station for the Study of Insects in the Harriman State Park near Tuxedo, New York. Since all of the Nature Trail activities have been transferred to Bear Mountain, more emphasis will be laid this summer on the primary purpose of the Station, which will continue to be under the direction of Curator Lutz.

MAMMALS

SOUTH ASIATIC MAMMAL GROUPS.—On April 23 last, there was placed on public exhibition at the American Museum, a series of groups of South Asiatic mammals which have been collected by Arthur S. Vernay and Col. J. C. Faunthorpe during the last five years. These groups form the nucleus for the exhibits that are to be installed in the new hall to be devoted to the large game animals of India, and are the gift of Arthur S. Vernay.

The admirably realistic results obtained are

due in many respects to the ability and inventive genius of Carl Akeley, who, as far back as twenty-five years ago, devised the taxidermy methods in use at the Museum at the present time.

The work of the Indian Hall is being carried on under the able direction of Assistant Director James L. Clark in charge of preparation, in collaboration with R. H. Rockwell, Louis Jonas, and John Hope, taxidermists of the Museum staff.

MR. GEORGE G. GOODWIN is about to start field work in Connecticut, preparatory to the writing of a report on the mammals of that State. The work is supported jointly by the American Museum of Natural History and the Connecticut Geological and Natural History Survey.

HONORS

PROF. HENRY FAIRFIELD OSBORN was awarded the degree of Doctor of Laws by Union College, Schenectady, on June 11, in recognition of the active part he has taken in exploration and in the discovery of remains of extinct animal life, and in the interpretation of these discoveries, which has resulted in important advances in the science.

DIRECTOR SHERWOOD HONORED.—On June 18, Brown University conferred upon Director George H. Sherwood of the American Museum, the degree of Doctor of Education in recognition of the work accomplished by him in the educational field, especially in connection with the Museum and the schools of New York City.

LINCOLN ELLSWORTH, a trustee of the American Museum, who with Roald Amundsen made the now historic Polar Flight of 1925 and the Transpolar Flight of 1926, has been awarded a gold medal by an Act of the Seventieth Congress of the United States of America, in recognition of his courage, sagacity, and perseverance. By the same Act, President Coolidge was authorized to receive from Mr. Ellsworth in the name of the nation, the flag which he took from King's Bay over the North Pole to Alaska. This flag is at present on exhibition in the American Museum. A reproduction of the original Act is shown on this page.

The story of these two polar flights appeared in NATURAL HISTORY for May–June, 1927.

DR. E. E. LOWE, director of the Leicester City Museum Libraries, in a report recently published in *The Museums Journal*, speaks in a highly complimentary manner of the American Museums which he toured last year. The American Museum is pleased to note that he commented upon the coöperation of the museums of this country with the school children, and singled out for special praise the American Museum for its prospective activities in natural history education.

S. 3919

Seventieth Congress of the United States of America:

At the First Session,

Begun and held at the City of Washington on Monday, the 5th day of December, one thousand nine hundred and twenty-seven.

AN ACT

Awarding a gold medal to Lincoln Ellsworth.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States is hereby authorized to present a gold medal to Lincoln Ellsworth, the distinguished American explorer, who, by his conspicuous courage, sagacity, and perseverance made his famous polar flight of 1925, and the transpolar flight of 1926, and the President is further authorized to present gold medals of honor to Roald Amundsen, the distinguished Norwegian explorer, and to Umberto Nobile, the distinguished Italian explorer, who participated with the said Lincoln Ellsworth in the transpolar flight of 1926.

SEC. 2. That the President of the United States is hereby authorized to receive, in the name of the Nation, the American flag which the said Lincoln Ellsworth took over the top from Kings Bay over the North Pole to Point Barrow and Teller, Alaska.

Speaker of the House of Representatives.

Vice President of the United States and President of the Senate.

CONSERVATION

DESTRUCTION OF THE CUMBERLAND FALLS.—Although they have been but little visited by tourists, the Cumberland Falls, on the Cumberland River below Williamsburg in southeastern Kentucky, are, after Niagara Falls, the finest and greatest in the eastern half of the United States.

As the Cumberland River is in part a navigable one, the control of these falls comes under the Federal Power Commission, with which the Cumberland Hydro-Electric Power company has filed an application to construct a dam and power development that will ruin the falls from a scenic standpoint, in spite of claims to the contrary by the electric company. Numerous other sites for power development exist in that region and the destruction of one of the grandest scenic places in the eastern states is needless.

An offer to purchase 2200 acres of land, including and surrounding the falls, and give it to the state for a park, has been made by Senator Coleman Du Pont. He has also offered to reimburse the electric company for all expenses (for surveys, investigations, etc.), thus far incurred, but the company has exercised its option and purchased 200 acres at the falls to which its claim entitled it.

Nothing now stands in the way of the immediate destruction of the falls except the Federal Power Commission, which will doubtless soon give its consent to the application unless public opinion makes itself heard without delay.

The Cumberland Falls Preservation Association, 319 East Main Street, Corbin, Kentucky, is making an effort to have the falls preserved and made a state park, and will be glad to furnish information or receive help. Letters of protest against the destruction of the Cumberland Falls should be sent to the Federal Power Commission, Washington, D. C. or to the Secretaries of Agriculture, War, or the Interior, who are members of it.

To Save the Antelope.—As a culmination of the efforts of wild life conservationists extending over a period of several years, a definite step has just been taken to perserve the remnant of the prong-horned antelope of the Nevada-Oregon region. Some time ago at a national conference called in Washington to consider means of saving these beautiful animals in the semi-desert regions of the West, the National Association of Audubon Societies was appointed to take the lead in securing by congressional action the establishment of an antelope and sage hen reservation in southeastern Oregon. Political interference at the behest of the nomadic sheep herding interests caused the project to fail. Since that time the state of Oregon has declared the killing of antelope in this region to be illegal, but as no wardens are available to enforce the regulation, conditions so far as the antelope are concerned remain virtually unchanged. Reports are current that wandering sheep herders and other travelers of the deserts continue to destroy the small bands of antelope that still remain. Across the line in Nevada an analogous situation exists, but it is here that a real reservation has at last been created.

While Dr. T. Gilbert Pearson, president of the Audubon Association, was engaged in field work in the west last summer, he learned from E. R. Sans of Reno, of the peculiar conditions that surround the Last Chance Ranch in northern Nevada. This range of 880 acres owned by the Hapgood Brothers contains open water, and water in this desert means many things, one of which is that from great distances antelopes come in spring to drop their fawns on the slopes surrounding the water hole.

"We have taken over the Last Chance Ranch of the Hapgood Brothers for an antelope sanctuary," said Doctor Pearson "and it is hoped that for all time we will thus be able to preserve much of the herd of antelope that still remains northern Nevada.

"While the National Association of Audubon Societies has for many years been working with others to preserve the remnant of big game in the west, all the reservations and sanctuaries we have thus far acquired have been for the preservation of ducks, geese, and other forms of bird life."

Doctor Pearson gave much praise to Mr. Sans of Reno, whose deep interest in the saving of these rare animals, he said, made possible the acquisition of this territory.—R. T. Hatt.

MARINE LIFE

American Sperm Whaling.—Two more of the eight cartoons of the Benson murals, illustrating whaling along the New England coast, have been received, and Mr. A. A. Jansson of the Museum's department of preparation is busily engaged in painting the large canvases from the originals. Dr. R. C. Murphy is supervising the technical details of these murals, which are to occupy the lunettes in the new Hall of Ocean Life.

The department of lower invertebrates regrets to announce the death of Mr. Robert H. Hazard, on April 7, at the age of seventy-four. Mr. Hazard was first connected with the American Museum in 1908, and was well known to all visitors to the Darwin Hall of Biology, where his duties were those of departmental docent. He was a gentleman of considerable culture and had an excellent command of language. His tact in approaching visitors and the lucidity with which he explained the exhibits in the Darwin Hall were great factors in increasing their educational value. Mr. Hazard had been seriously ill for more than a year. He will be greatly missed, not only by his friends, but by the visitors to the Darwin Hall.

The New Rotifer Group in the Darwin Hall has been completed, and will be placed on exhibi-

tion in September, when the general redecoration and remodeling of the hall is finished. The group shows the microscopic life contained within one-half an inch of pond bottom, magnified 100 diameters, or, cubically, 1,000,000 times. The remarkable complexity of life within so small an area is well illustrated in this group, which in itself is an unusual demonstration of skill in glass modeling on the part of Mr. Herman Mueller, of the departmental technical staff. A more detailed account of the group will be presented in a later number of NATURAL HISTORY.

MINERALS

CURATOR HERBERT P. WHITLOCK has been recently elected president of the New York Mineralogical Club to succeed Prof. Paul F. Kerr.

Curator Whitlock also was selected to represent the New York State Museum at the inauguration of Dr. Frederick B. Robinson as fifth President of the College of the City of New York.

REPTILES AND AMPHIBIANS

EXPERIMENTAL BIOLOGY IN THE AMERICAN MUSEUM.—Naturalists for centuries have been recording the *course* of evolution and have speculated as to its *causes*. Experimental biology has shown us that the gene is the physical basis of heredity, but it has not shown us how the gene does its work or exactly what the relation of the invisible gene to the visible character might be. The hereditary process may be likened to a complicated machine. We know what materials go into it and what products come out, but by what stages these materials are changed into the final product still remains a great problem for investigation.

For some time Doctor Noble of the Museum staff has been making an experimental study of species characters. His papers include investigations on the causes of retarded development in the permanently aquatic salamanders, usually called perennibranchs; the factors controlling the form of the teeth in certain salamanders; and the changes in the structure of the heart correlated with cutaneous respiration. In a paper recently published in the *Journal of Morphology and Physiology* Doctor Noble and Miss Jaeckle have worked out the evolution of the tree-climbing apparatus of the tree frogs, and have found that this highly adaptive mechanism arose in phylogeny before the frogs became arboreal; further, it was retained in other species which have taken up again the terrestrial habit. In brief, Doctor Noble and his associates have been analyzing the origin of adaptations and the determiners of species characters. They have in progress extensive experimental studies on the causes of blindness in the blind salamanders, the factors controlling tooth form in vertebrates, and the factors which determine the color pattern of animals.

The Trustees of the American Museum in recognition of these important contributions to general biology have recently changed the name of the department of which Doctor Noble is curator, to "The Department of Herpetology and Experimental Biology." Further plans are well in hand to make experimental biological investigation one of the major research activities of the Museum.

SALAMANDERING IN THE GREAT SMOKIES.—Mr. William G. Hassler has recently returned from the Gatlinburg area of the Great Smokies where he has been making extensive collections of salamanders which are to be used in experimental research.

SCIENCE OF MAN

THROUGH THE INTEREST AND PATRONAGE OF MR. MYRON I. GRANGER, of New York City, the American Museum is sending an ethnological expedition to Dutch Guiana under the leadership of Dr. Morton C. Kahn, the objective being to collect and study among the Bush Negro colonies in that country. Doctor Kahn visited some of the Bush Negro villages last season and brought to the Museum a very interesting collection. An account of these people appears on page 243 of this issue of NATURAL HISTORY.

THE MARCH-APRIL COVER DESIGN OF "NATURAL HISTORY"

An excellent example of the possibilities of using skin-color records made by the Bradley Color Top method in the study of racial types is shown in the color reproduction of an Australian head appearing on the cover of the March-April number of NATURAL HISTORY. Mr. A. A. Janssen, the artist, had as a guide, skin-color data recorded in this way by C. B. Davenport of Cold Spring Harbor on his recent visit to Australia.

MEETINGS OF SOCIETIES

THE INTERNATIONAL CONGRESS OF ENTOMOLOGY will hold its formal meetings at Ithaca, beginning August 12, but most of the foreign delegates, especially those from England, France, and Spain, will arrive in New York City on the "Tuscania" three days before leaving for Ithaca. Curator Lutz has been requested to arrange a program of scientific sight-seeing for these three days and then, meeting the delegates coming on a second boat, proceed with the united party to Ithaca. New York headquarters for the Congress will be in the East Tower room on the third floor of the American Museum.

A CONSIDERABLE ATTENDANCE FROM ABROAD is already assured for the TWENTY-THIRD SESSION OF THE INTERNATIONAL CONGRESS OF AMERICANISTS, who are to be the guests of the American Museum of Natural History during the week beginning September 17. Meetings will also be held at Columbia University, the Museum of the American Indian (Heye Foundation), and the Brooklyn Museum. There will be one general session and several sectional meetings.

The first of these Congresses was held in Nancy, France, in 1875, for the purpose of discussing the native races of America, their history, languages, habits, and customs. Frequent sessions were held in Europe until 1900 when, at a meeting in Paris, revision in the constitution provided for biennial sessions alternating between the Old and the New World. The Thirteenth Session also was held at the American Museum in October, 1902, when Morris K. Jesup, the president of the Museum, was president of the Congress.

LINNÆAN SOCIETY'S MEDAL GOES TO DR. MERRIAM—The Linnæan Society's Medal, awarded to Dr. C. Hart Merriam for his eminent work in mammalogy, ornithology, and zoögeography, was presented to Doctor Merriam by Dr. Frank M. Chapman in Washington, D. C., on May 30. Doctor Merriam was one of the founders as well as the first president of the Linnæan Society of New York, which has recently celebrated its Fiftieth Anniversary; and the first two volumes of the *Transactions* of the Society are largely devoted to Doctor Merriam's historic report on the "Mammals of the Adirondack Region." His distinguished career as Chief of the United States Bureau of Biological Survey is universally known.

The previous recipients of the Linnæan Medal are Dr. Frank M. Chapman, Dr. D. G. Elliot, and Dr. J. A. Allen. The Linnæan Society was founded on March 7, 1878, by H. B. Bailey, F. Benner, E. P. Bicknell, John Burroughs, Harold Herrick, Dr. F. H. Hoadley, Ernest Ingersoll, N. T. Lawrence, Doctor Merriam, and William C. Osborn. For some years its meetings were usually held in the rooms of the American Geographial Society, 11 West Twenty-ninth Street, but since 1891 the Society has met in the American Museum. Following Doctor Merriam, the successive presidents of the Linnæan Society have been: E. P. Bicknell, G. B. Sennett, Dr. J. A. Allen, Dr. F. M. Chapman, Dr. J. Dwight, Walter Granger, J. T. Nichols, Dr. E. R. P. Janvrin, Ludlow Griscom, and J. P. Chapin.

From the outset the Linnæan Society's interests have been largely ornithological, although other branches of vertebrate zoölogy have not been overlooked. The Society has always exercised a most valuable influence in the training of young naturalists, and has been a favorite meeting place for them in later years as they pursued their studies and returned from their travels. There are indeed few areas of the world that have not been visited by trained observers from among the members of the Linnæan Society.

The Golden Anniversary of the Society was appropriately celebrated on March 13, 1928. At the Fiftieth Anniversary Dinner, held at the Manhattan Square Hotel, two of the founders, Messrs. Herrick and Ingersoll, were present, as well as two of the first members subsequently elected to the Society, Drs. G. B. Grinnell and A. K. Fisher. Doctor Merriam, Mr. Benner, and Mr. W. C. Osborn sent their regrets that they were unable to attend. The Anniversary Meeting, held afterward at the American Museum, was addressed by those of the founders, former presidents, and early members who were present. Their reminiscences were illustrated by many lantern-slides from photographs of officers and members who had taken an active part in the work of the Society, showing them often in field costume, or at work in distant corners of the world.

AMERICAN MUSEUM BUILDING PLANS

THE BOARD OF ESTIMATE AND APPORTIONMENT is continuing the building program of the American Museum, and on May 7 approved $150,000 for the preparation of plans and specifications of the African Hall (Section 13 of the Museum building) and the power and service section (Section 17). The estimated cost of these two buildings will be $2,000,000.

The African Hall is greatly needed for the exhibition of the superb African groups presented by George R. Eastman, Daniel E. Pomeroy, Daniel Wentz, Arthur S. Vernay, and others. The service and power section is required for the adequate heating and lighting of existing buildings, and the new sections of the Roosevelt Memorial. Messrs. Trowbridge and Livingston have been appointed architects for both these sections, and it is expected that the plans will be completed so that these buildings can be erected at the same time the Roosevelt Memorial Building is being built by New York State early in 1929.

THE FIFTY-NINTH ANNUAL REPORT of the American Museum, entitled "Building the American Museum" was issued on May 1, 1928. In this report President Osborn gives the history of the building and future construction needs. Included in the report is the series of plans through

which the architects have finally developed the plan that is now being carried out. The first plan was prepared by Alfred S. Bickmore in 1863, after a conference with Sir Richard Owen, director of the British Museum, South Kensington. During the twelve following years, the plan was greatly elaborated and, from a single elongated series of halls, it was changed to an enormous square with four additional halls making a cross and meeting in its center. Basically the plan of 1875 is the one that is now being developed, although in the intervening years many changes and improvements have been incorporated into the plan.

ERRATUM

Unfortunately, the illustration on page 203 of the March–April NATURAL HISTORY, showing an Indian hunting party returning to its encampment, was wrongly credited to Carl Bodmer instead of to William De La M. Cary. The original painting, entitled "A Crow Hunting Camp," was one of a collection that Mr. Cary exhibited at the American Museum of Natural History in 1917. This collection was of much historic interest, as most of the scenes were painted between the years 1861 and 1875, and present faithful pictures of many phases of plains life before the coming of the railroad.

NATURAL HISTORY is glad to make this correction, and to give due credit to Mr. Cary, who so graphically painted these old-time scenes of Indian and pioneer American life.

NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum, making the total membership 10,500.

Associate Founder

Mr. EDWARD S. HARKNESS.

Honorary Fellow

Mr. WILLIAM J. MORDEN.

Honorary Life Members

Messrs. ROLLO HOWARD BECK, STEPHEN KLASSEN.

Patron

Mr. WILLIAM HALE HARKNESS.

Life Members

Mesdames DAVID C. HANRAHAN, KATHERINE POMEROY.

Miss MILDRED KAMSLER.

Captain DAVID C. HANRAHAN.

Messrs. FRANK L. CONNABLE, RAYMOND M. CURTIS, HARRY P. DAVISON, CLIFFORD HEMPHILL, ROLAND M. HOOKER, FRANKLIN J. HORNE, C. ALAN HUDSON, H. DAVIS IVES, AUGUSTUS HOWARD IVINS.

Sustaining Member

Mr. HANS WICKENHAUSER.

Annual Members

Mesdames JAMES BOYD, GERTRUDE E. CASE, STEPHEN MERRELL CLEMENT, AARON DAVIS, ERNESTO G. FABBRI, ELBERT H. GARY, WALTER L. GOODWIN, GEORGE A. GOSS, CLAIRE ADAMS HAMPTON, T. MITCHELL HASTINGS, RUSSELL A. HIBBS, ANSON P. S. HOYT, JOHN CHAMBERS HUGHES, FREDERICK E. HYDE, GEORGE H. INGALLS, EMMET W. IRVING, ROBERT JAFFRAY, HENRY R. KUNHARDT, BIRD LEWIS, MOSES TAYLOR.

Sister ST. RODRIGUE.

Misses MARJORIE E. ASHFORD, AUGUSTA P. DIXON, ELIZABETH W. EMMONS, IRENE ERISTOFF, MARY CECILIA FAIRFAX, BEATRICE GALLATIN, MARGARET H. GALLATIN, GERALDINE C. HALL, KATHERINE T. HALSEY, ISABEL HASTINGS, MARY LENA HAYDEN, SARA K. HUDSON, GRACE ELLIS TAFT.

Doctors KIRBY DWIGHT, WILLIAM W. HERRICK, BEVERLY C. SMITH.

Rear Admiral FREDERIC R. HARRIS.

Messrs. LISLE R. BEARDSLEE, CHARLES D. BREWER, ROBERT H. DELAFIELD, ALFRED ELY, MYRON S. FALK, LEIGH FRENCH, JR., SIMON GOODFRIEND, JAMES VARNUM GRAHAM, E. BAYARD HALSTED, T. A. HATCH, RALPH P. HINCHMAN, MILTON HOLDEN, NELSON C. HOLLAND, BURTON HOLMES, JOHN N. HOPKINSON, HENRY R. HOYT, DANIEL E. HUGER, RICHARD H. HUNT, RANDOLPH JENKS, CHARLES W. KELLOGG, W. FLOYD KENDALL, F. P. KEPPEL, DARWIN P. KINGSLEY, JR., WILLIAM KRIPPNER, A. NELSON LEWIS, ROBERT W. MALONEY, DANIEL MASOR, DON V. MESSER, HENRY MOIR, NOEL MORSS, CARL L. MULLER, JOHN O. RADWAY, C. S. SARGENT, LAWRENCE COPLEY THAW, JOHN W. THOMSON, A. L. MURPHY VHAY, ORLANDO B. WILLCOX.

Master JAMES M. MONTGOMERY.

Associate Members

Prof. MABEL BISHOP.

Mesdames J. T. F. BAEYERTZ, CHARLES BELDEN, MABLE P. BOWERS, MARTHA M. BUCKLIN, HALSEY DEWOLF, FREDERICK B. DOWNING, WILLIAM B. DREW, GASTON FOURNIER, DWIGHT L. FULLERTON, MADELEINE C. HUIGINN, WM. A. KRIEGER, STEPHEN L. MALONE, VALENTINE

Marsh, Louie W. Mayall, Ellen C. McCornack, Aime F. Millet, Alex. Schmidt, Fred Lincoln Smith, Theodore F. Tillinghast, Hattie Carpenter Webb, W. C. Witherbee.

Misses Inez Dunkelberger, Bertha Foote, Frances Gamble, Martha E. Goodwin, Helen Hart, Jessie L. Hildreth, Frances La Follette, Helen M. Law, Honour McCreery, Morley, Dorothy M. Perrin, Anna D. Slocum, Annie H. Thwing, Annie J. Walker.

Rev. V. A. Huard, Jos. B. Mignault, Henry Attwell Post.

Prof. Edward W. Berry, Julian S. Huxley, M. E. Kleckner, W. A. Matheny.

Doctors H. L. Babcock, B. R. Bales, Malvern B. Clopton, Victor W. Cowan, A. de Clairmont, C. V. Esterly, P. E. Fisher, Geo. Edw. Follansbee, Ing. Otto Fuchs, H. F. Harvey, Ralph A. Hix, Lombard C. Jones, A. V. Kidder, Henry La Motte, O. R. Langworthy, Albert B. Lewis, Etienne Loppé, J. H. Mills, Walter F. Provan, William James Reagan, Elmer S. Riggs, E. P. Ruggles, R. Morton Smith, E. MacD. Stanton, Fred W. Taylor, F. J. Van Kirk, John C. Warbrick, Arthur Frederic Wark, Frank J. Weber, Frank B. Young.

Major C. H. Rice.

Captain E. S. Rowley.

Sr. don José Felix Tamayo.

Messrs. Jacob Bates Abbott, R. L. Agassiz, Walter Ayres, Carl Armstrong, Wallace I. Atherton, Gordon Bassett, William Blodget, Joseph W. Bonewitz, Robert E. Briggs, Stanley Bright, Leonard R. Brightwell, Walter S. Brinkmann, Ernest W. Brown, Wm. Sims Bunn, N. H. Busey, Jr., D. S. Carpenter, L. H. Chalmers, W. Lee Chambers, Edward G. Clapham, Wm. S. Clawson, Lewis Dawes, Francisco P. de Carvalho, Alvin H. Dewey, F. F. Dicke, Fred M. Dille, James Harrison Donahey, George D. Doughty, E. Raymond Driver, H. O. Edmonds, Edw. C. Ehni, H. H. Ficken, Daniel J. Fink, J. H. Firey, E. Franklin, D. E. Frederick, A. C. Freeborn, C. Freeman, Edward Frost, Jr., Henry C. Galster, Gibson Gardner, Charles A. Gianini, Arthur M. Griffin, H. R. Hamilton, Jr., Caryl Parker Haskins, Loomis Havemeyer, Paul E. Hering, H. Hoagland, G. M. Hohl, Bain Hoopes, Bruce Howe, Francis Welles Hunnewell, Ralph T. Huntley, Lorenzo Jaunarena, James L. Jenks, Coloman Jonas, F. B. Kervan, E. L. King, Alan D. Kinsley, Ralph G. Klieforth, Clyde K. Kluckholm, J. B. Knight, Ernst C. Krohn, Yung Kwai, George N. Lamb, J. W. Lilienthal, Jr., F. Clarence Lind, C. M. Litch, H. N. Lowe, James Mac Laren, Arthur Mee, Charles D. Michener, Thomas Moore, Francis Morris, Alva Morrison, Penfield Mower, E. W. Mulford, A. C. Nydegger, William H. Over, Samuel J. Pashley, Fred Perry, Ellis C. Persing, George Peter, L. G. Pike, Harold A. Pitman, Frank R. Powley, Alfred L. Ransome, Arthur A. Rejna, Harry Rickel, Oliver Ricketson, Jr., L. D. Rickey, Athol E. Rollins, Albert Rosenthal, Leland L. Rounds, B. Seebohm Rowntree, Geo. B. Saunders, Jr., G. H. Schatz, Arthur J. Schenck, William A. Schipp, Edward Schroeder, Luther H. Schroeder, Arthur M. Scott, David Scott, Joseph W. Sharp, Jr., Kenneth E. Shawcross, M. L. Shields, J. S. Shortle, R. C. Skiles, A. Page Smith, Stanley N. Smith, Z. C. Smith, Lewis C. Snyder, M. H. Spaulding, Thomas E. Stone, Arthur Percival Stubbs, O. T. Stubbs, O. H. Swezey, Horace Taylor, H. C. Teel, Frank Thiel, Geo. D. Uibel, Bryant Walker, J. M. Watkins, Walter A. Weber, Geo. E. Wells, Courtney Werner, LeRoy Wilcox, Claude O. Winans, H. C. Witwer, E. M. Womack, Jr., Dana Bruce Wotkyns, William W. Yarwood.

Master Harry H. Everett, Jr.